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JPRS-CEN-93-006 CONTENTS 23 June 1993

NUCLEAR POWER

Highlights from the 1993 National Energy Conference: Accelerating the Growth of the Power Industry

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[Article by Shi Dazhen [0670 1129 2823]: "Liberate Ideology, Seek Truth from Facts, Rely More on Reform and Policies, Accelerate Development of China's Electric Power Industry: Excerpts from Speech to the 1993 National Energy Resource Work Conference"]

[Text] Overall, the current situation in China's electric power industry is that it is developing very quickly, has great potential, and has challenges and even greater opportunities.

I. The Situation in Our Electric Power Industry

A. Since reform and opening up, China's electric power industry has made significant achievements

Since reform and opening up, the development of China's electric power industry has attracted world attention. China leapt to fourth place in the world in power output and installed generating capacity in 1987 and we have consistently maintained a good momentum of rapid growth. This is especially true during the 5 years since the Ministry of Energy Resources was established, with our average annual installed generating capacity exceeding 10,000MW every year. This included over 10,000MW in new large and medium-sized generators placed into operation during 1991 and 1992, when the amount reached 10,530MW and 12,176.8MW, respectively. We added a total of 60,000MW in new installed generating capacity over the 5-year period, which is equivalent to the total installed generating capacity during the 30 years prior to reform and opening up. Economic diversification in electric power began in 1984 and has developed substantially since 1989. We achieved our planned development objective of a gross income of 10 billion yuan 8 years ahead of schedule in 1992, which is equivalent to about one-seventh of the income or our primary industries.

1. China's electric power industry has entered a new stage of large generators, large power plants, large grids, high voltages, and a high degree of automation. At the end of 1992, thermal power generators with a unit capacity of 200MW and larger accounted for 42 percent of China's total thermal power installed generating capacity and hydropower generators with a unit capacity of 100MW and larger accounted for 33 percent of China's total hydropower installed generating capacity. China now has 25 power plants with installed generating capacities greater than 1,000MW. China now has four multi-provincial power grids with capacities greater than 20,000MW and three power grids with capacities greater than 10,000MW. Automatic dispatching systems in the four large grids that have attained advanced international levels of the 1980's and some provincial grids have now attained functional requirements.

2. A big group of advanced models have appeared on the electric power battlefront. In electric power capital construction, for example, those with fast and good progress in projects include construction of Shandong's Hualu Power Plant, Shanghai's Shidongkou No 2 Power Plant, Shanxi's Zhangze Power Plant and Shentou No 2 Power Plant, Fujian's Shuikou Power Plant, Guangzhou Pumped-Storage Power Station, Guangxi's Yantan Power Station, Yunnan's Manwan Power Station, and Hubei's Geheyan Power Station. In work to attain objectives in safe and civilized production in electric power production enterprises, the Ministry of Energy Resources and various grids and provincial bureaus have named several enterprises that have attained objectives. They include 34 thermal power plants named by the Ministry of Energy Resources as having attained objectives and more than 40 thermal power plants that it has commended as having made significant achievements. In the area of rural electrification work, the Ministry of Energy Resources has named 47 rural electrification enterprises as "three fors" units that have attained objectives. In the area of electric power economic diversification, Dalian Central Power Plant and the Linfen Power Industry Bureau have taken a new path. In the area of electric power S&T work, the Ministry of Energy Resources' Nanjing Automation Institute has used reform to integrate technology, industry, and trade and has begun to have the conditions for economic self-determination and self-development. In the area of electric power education work, the Ministry of Energy Resources CPC Organization has made a special "Decision On Undertaking Activities To Study Linfen Electric Power Technical School" and named Shenyang Electric Power Training School a "higher education pacesetter." It also commended several Linfen-type advanced schools during the first quarter of 1993. There are many advanced units and individuals in all areas of the electric power industry that cannot be listed here.

3. Important advances have been made in reform of China's electric power industry system. First, multi-channel, multi-level, and multi-form raising of capital to develop power began flourishing in 1984 and it has now fundamentally transformed the structure of investment in electric power in China. Second, in accordance with the principles of "separation of government and enterprises, provinces as the entity, integrated power grids, unified dispatching, raising capital to develop power" and "adapting to local areas and grids" formulated by the State Council and the program for reform of the electric power industry management system approved by the 1988 State Council Document No 72, the Ministry of Energy Resources has basically completed work to establish the related electric power joint companies (corporations) and provincial, municipal, and autonomous region electric power companies. In December, 1991, the State Council approved the establishment of five large multi-province power grid trial points for the establishment of electric power enterprise groups. Third, the state has prepared a series of policies for the electric power industry that have had a far-reaching impact on development and reform in the electric power industry.

To summarize, China's electric power industry has made significant achievements and these achievements are the result of reform and opening up, the result of the arduous efforts of all cadres and employees on the electric power battlefront and comrades in organs of the Ministry of Energy Resources under the correct leadership of the CPC Central Committee and the State Council and with substantial support from all departments and regions, and the result of further reliance on reform and policies in the 5 years since the Ministry of Energy Resources was established to develop China's energy resource industry.

B. Development and reform in the electric power industry still face a heavy burden and a long path

The 14th CPC Central Committee clearly pointed out that the 1990's are a key period in China's economic development during which the overall quality of China's national economy and our comprehensive national strengths will step up to a new stage. To deal with this important strategic task, during the next 8 years, as China's electric power industry tries to resolve the contradiction of a power shortage it must also meet the requirement of 8 to 9 percent yearly growth in our national economy and it must find a way to guarantee that our people's livelihood moves from having sufficient food and clothing to being relatively prosperous and find a way to further liberate and develop the forces of production in the electric power industry so that the primary technical economics indices in several key electric power enterprises approach or attain advanced international levels. Given the fact that China still has a rural population of 140 million that does not have electricity supplies, that per capita electricity use in China ranks 80th in the world, and that electricity as a proportion of total energy resource consumption in China lags about 20 years behind average world levels, there is much we should do to accelerate development of China's electric power industry. To deal with the reality that coal consumption to supply electricity in China's electric power enterprises is 100 grams/kWh higher than advanced international levels and that the number of employees per unit of installed generating capacity is several times higher than advanced international levels, there is similarly much that we should do to make a significant improvement in labor productivity and economic results in China's electric power enterprises. We should note clearly that: 1) Although China's electric power industry has made great achievements, our electricity supplies are still far from meeting the need for a rapid improvement in our peoples' living standards and far from able to meet the need for rapid growth of our national economy. After improvement and rectification during the past 2 years there was a trend toward alleviation of the contradiction between supply and demand for a period, but since 1992 most power grids have been facing a situation of power shortages and restricted power supplies to varying degrees. In 1991 the Ministry of Energy Resources CPC Organization decided that we must guarantee basic electricity supplies for urban and rural people's lives, and it should be stated that this is a starting requirement for electric power supplies, but because of the power shortage, economic departments and power industry departments in all areas have been feeling substantial pressures. Moreover, the impact of the power shortage on the electric power industry itself cannot be ignored. Operating power generation equipment at too great of an intensity seriously affects the reliability, economy, and lifespan of the equipment itself. Furthermore, there are about 20,000MW of moderate and low-pressure generators in China's power grids that require thorough upgrading or equipment replacement as well as 7,000MW of hydropower generators with serious defects and 6,000MW of heat supply generators that are in operation beyond their service lives. The grid and low-voltage power distribution grid equipment in many of China's cities is outdated, which affects the operating safety, reliability, and economy of our grids. 2) If we wish to solve our power shortage problems, we must rely on reform, policies, and increased investments, continue unwavering adherence to the route of raising capital to develop power, and resolutely follow the principle of coordinating development of the electric power industry with growth in our national economy and resolutely combine development with conservation. However, because electricity prices have not been straightened out, the rate of profit on capital in the electric power industry has dropped below 3.7 percent, which can only compel it to sustain simple reproduction and prohibit it from carrying out expanded reproduction, and this is not favorable for conservation of energy and electricity in society as a whole. Moreover, electric power enterprises are far from forming comprehensive administrative mechanisms. With the exception of a few of Huaneng's enterprises, most enterprises have extremely limited decision-making rights. For example, all electric power enterprise groups and provincial electric power companies still basically have no investment decision-making rights, capital fund rights, foreign trade rights, and so on. Economic policies for China's electric power industry also require additional readjustment. Raising capital to develop power also requires further perfection of systems and policies to gradually guide it towards developing large-scale and not small-scale thermal power, developing both thermal power and hydropower, and building power sources as well as power grids to achieve coordinated development of power sources and power grids. Regions having the proper conditions can implement multi-administrative region joint power development and replace the transportation of coal with transmission of power to reduce the restrictive role of coal transportation on development of the electric power industry and achieve a rational deployment of resources. In summary, development and reform of China's electric power industry still have heavy burdens.

From the time that comrade [Deng] Xiaoping gave his important talk during his tour of southern China to the victorious convening of the 14th CPC Central Committee, a great opportunity for accelerated development of China's electric power industry arrived. The 14th CPC Central went further in clearly pointing out that the goal in reform of China's economic system is to establish a socialist market economy system to aid in further liberation and development of the forces of production and thus pointed

the way ahead in China's socialist modernization and construction. Thus, if we merely liberate our ideology, seek truth from facts, experiment boldly, make timely summarizations, and continue to advance in this direction, we will certainly be able to thoroughly liberate ourselves from the fetters of the traditional purely planned economic system and find a regular law that conforms to development of the electric power system and conforms to the development path of the operational laws of a socialist market economy. China's electric power industry now faces both challenges and opportunities. Using the spirit of reform, seizing historical opportunities, accepting the challenges of the era, accelerating the development of China's electric power industry, and making significant improvements in labor productivity and economic results in electric power enterprises are important historical tasks for all cadres and employees on the electric power battlefront during the 1990's.

II. Further Intensify Reform, Continually Create a New Situation in China's Electric Power Industry

A people's power industry that serves the people is the aim of power industry departments. Providing high-quality, reliable, and inexpensive electric power to users to continually meet the requirements for development of our national economy and the people's lives is the fundamental goal of the electric power industry. Strive for a fundamental resolution of the power shortage situation on a national scale by the end of this century: eliminate counties that do not have electricity, attain a basic absence of power shortages in some regions, attain first-rate levels in China in several electric power enterprises, and attain or approach advanced international levels in several electric power enterprises. To accomplish this, we must focus on the work below.

A. We must further strengthen the principal consciousness of reform and opening up in electric power enterprises

Further strengthening the principal consciousness of reform and opening up in electric power enterprises is necessary to speed up development of the electric power industry. To develop China's electric power industry, we must strengthen international condition and exchanges, import more advanced technology and management experience from foreign countries, and import capital and key equipment as appropriate from foreign countries, and we must start with the reality of the imbalance in China's economic development and primary energy resource distribution, start with the law that the development of our electric power industry must involve the development of large power grids, start with the need to help improve China's energy resource structure and achieve a rational deployment of resources, and take the route of joint development of electric power.

Further reinforcement of the principal consciousness of reform and opening up in electric power enterprises is a requirement for liberating and developing the forces of production in China's electric power enterprises. First, power plants and power supply bureaus need to have administrative decision-making rights and strengthen their principal consciousness of reform and opening up. In hydropower construction, several enterprises with relatively poor technical and equipment conditions, rather weak management foundations, and quite a few leftover historical problems are actively taking the initiative to participate in market competition and have made their enterprises exist and develop in the competition. This is also the case in economically diversified electric power enterprises. All of those enterprises that have actively taken the initiative in making a transition from a dependent type to a self-development type, from a closed type to an open type, and from the product economy to the market economy are flourishing and growing.

Further reinforcement of the principal consciousness of reform and opening up in electric power enterprises is a requirement for adapting to the development of socialist market economy. Electric power is a public enterprise, and there cannot be two overlapping power grids in the same region, so it basically is still a monopoly industry. Many countries in the world have implemented a form of control method for electric power enterprises. Why is electric power basically an industry of regional monopolies? This is determined by the characteristics of the electric power industry. Because power generation, power transmission, power transformation, and power distribution are accomplished instantaneously, the electric power industry must ensure the reliability of every link. Because electricity is hard to store, the continuity of its production must be guaranteed to continually supply users with electricity. Thus, it must also be ensured that power grids are an indivisible entity. Unified dispatching of electricity must be implemented within a particular grid. We must adhere to safety first in electric power production. Relative stability must be maintained in power supply regions, and so on. This is particularly true of the essential differences between electric power supply market and the regular commodities market in that free competition cannot be permitted. It deserves mention that it is precisely because electric power is basically still an industry of regional monopolies that the principal consciousness of reform opening up as the main factor in electric power enterprises should be strengthened in order to better adapt to the requirements for development of a socialist market economy has especially important significance. We should borrow from successful experiences in this area in the economically develop nations. In the developed countries, while there cannot be free competition in electric power and electric power enterprises are not permitted to go bankrupt, electric power companies bear market pressures that compel them to meet power use demand with top quality, reliably, and cheaply, electric power companies must strengthen their own ability to attract capital in intense market competition, and the behavior of electric power companies must conform to the requirements of the law of value. We have done a great deal of work based on the overall aim of having the people's electric power industry serve the people for many years, especially work regarding electric power management, that has accelerated progress in coordinated reforms and expanded the content

and scope of superior-quality services, made the work more solid, and led to substantial improvements in the business environment and quality of services in the electric power industry, but from electric power planning, design, and construction to production, operation, marketing, and services, we are still far from attaining "users first, service first", and it is hard to adapt to the requirements of developing a socialist market economy in services, benefits, time, and other concepts, so we must further strengthen the principal consciousness of reform and opening up in electric power enterprises.

B. We must motivate all initiative that can be motivated, apply every policy that can be applied, and use every bit of capital that can be utilized to accelerate development of the electric power industry

A fundamental characteristic of the electric power industry is increasing the forces of production, mainly through extensive expanded reproduction. Each 10,000MW placed into operation a year increases our production capacity by 10,000MW, which of course must have the associated matching facilities, so satisfying demand for electric power in our national economy and the people's lives objectively requires that the electric power industry maintain a coordinated proportional relationship between supply and demand capabilities in the electric power industry, and electric power must grow in synchronization with growth in our national economy. Because the electric power industry is also a capital-intensive industry, development of the electric power industry must rely on large investments. This is the case for capital construction in electric power, as is reliance on technical progress for energy conservation and reducing consumption in power grids and power plants. A relative insufficiency of investments in electric power has been a major problem that has vexed China's electric power industry for many years and it is one of the main problems that the development of China's electric power industry still faces at the present time.

From the perspective of the demands that accelerated development of our national economy places on the electric power industry, if the electric power industry fails to take the path of super-conventional accelerated growth, it will be impossible for electric power to be in the vanguard. To place electric power in the vanguard, the electric power industry must make efforts at intensive reform. Without reform, it has no way out.

Practice since reform and opening up has made us understand profoundly that we must be liberated from the ideological fetters of simply relying on the state to develop power, take the route of multi-channel, multi-level, and multi-form investments to develop power, take full advantage of both the domestic and international markets, two capital sources [domestic and foreign], and two types of capital to gradually establish and nurture socialist market mechanisms, make great efforts at raising electric power construction capital on a broad scope, and make great efforts at improving the utilization benefits of electric power construction capital. This is the essential way to invigorate China's electric power industry.

Since Comrade Xiaoping's talks on his tour of southern China during early 1992, all areas have taken many new actions in the area of opening up capital channels, which is a major advance. In this area, we must further liberate ideology, broaden our ideas, be somewhat bolder, take somewhat faster steps, and dare to explore. We must motivate all initiative that can be motivated, apply every policy that can be applied, and use every bit of capital that can be utilized to accelerate development of the electric power industry. We must adhere to the principle of adapting to local conditions, combined development of thermal power and hydropower, and appropriate development of nuclear power, and in particular we should make major efforts to develop hydropower and pit-mouth power plants. Hydropower should have the principle of combining large, medium, and small scales, carry out cascade, rolling, and river basin development, and speed up preparatory work for large and medium-sized hydropower stations. There must be unified planning and synchronized construction of power grids and power plants. In 1993, the Ministry of Energy Resources will focus on electric power shareholding investment mode trial point work in Shanghai and Shandong. We advocate and encourage all areas having the proper conditions to take the initiative in undertaking all types of trial point work or issuing internal stocks. We advocate and encourage the implementation of an active equilibrium in electric power development, and we should make major efforts to develop all electric power projects that do not require the state to make unified balances of the external conditions and that conform to the state's industrial policies.

C. We must work hard at transforming enterprise administrative mechanisms

Transforming enterprise administrative mechanisms is a strategic task that was deployed by the 14th CPC Central Committee as well as a central link in intensive reform of electric power enterprises, and we must earnestly focus on it. Based on the deployments made by the National Economic Work Conference, we will use transformation of government functions and reform of the state's organizational structure during 1993 to further clarify the relationship between the duties and rights of the state and enterprises. The 14 administrative decision-making rights given to enterprises in the "Regulations" have basically been implemented in state-owned enterprises. A social guarantee system has been established in a preliminary fashion and all state-owned enterprises can operate in accordance with the mechanisms stipulated in the "Regulations". To achieve the objectives outlined above in regard to the electric power industry, we must establish a spirit of advancing in the midst of difficulties. This is because transformation of electric power enterprise administrative mechanisms is extremely important as well as rather difficult. The reasons for the substantial difficulties are due to objective factors in the following areas. One, electric power is both a basic industry that concerns our national economy and people's livelihood and a "bottleneck" that has restricted development of our national economy for many years, and as a result it is subject to rather profound restriction by the ideology of the planned economy. Two,

the system of laws and regulations for the electric power industry is still very imperfect and there are many realms where there are no laws that can be relied upon. Three, there has still been no thorough reform of electricity prices and electric power enterprises still face many difficulties in achieving self-perfection and self-development. All of these things are an indication of the greater breadth and difficulty of transforming administrative mechanisms in electric power enterprises compared to regular industrial enterprises. To deal with these difficulties, we can only be more decisive, face the difficulties, and move forward. This is the ideological preparation we should make when transforming administrative mechanisms in electric power enterprises.

Second, transformation of the functions of government, including the central and local governments, is the key to implementing enterprise administrative decision-making rights. The Ministry of Energy Resources must do good work on better staff and simpler administration, transforming government functions, and improving work efficiency. Based on the demands of the 14th CPC Central Committee, strengthen unified planning, focus on the functions of government in the areas of information guidance, organizational coordination, providing services, and inspection and supervision, and it should no longer manage enterprise personnel, finances, and materials. For all things that electric power enterprises are themselves capable of handling and which are within the scope of the authority of the Ministry of Energy Resources, the Ministry will transfer 100 percent of the authority and support electric power enterprises in being the main factor in handling them in accordance with the law. For all those things that are outside of the scope of the authority of the Ministry of Energy Resources, the Ministry will strive to assist and support enterprises in striving to transfer the authority to enterprises. For all work which must be supported and coordinated by government departments, the Ministry of Energy Resources will certainly actively assist in dealing with it.

Third, along with transforming government functions and simplifying administration and transferring authority, enterprises should intensively undertake matching reform in the three systems [labor, wage, and personnel] and conscientiously transform their internal administrative mechanisms. All administrative decision-making rights should be implemented to their proper places, and they should truly understand that this is not that the functions of government have been transformed but that enterprise administrative mechanisms have been transformed. This is particularly true of another problem related to the rights that should be transferred down to electric power enterprise groups and provincial electric power companies to run basic-level enterprises well. Regardless of what level is the focus of the conversion of administrative decision-making rights in electric power enterprises, power generation and supply enterprises must establish intrinsic motivation and stimulation mechanisms. How to make power generation and supply enterprises become first-level independent accounting enterprises under the unified leadership of power grids should be an important aspect of the transformation of administrative mechanisms in electric power enterprises.

The electric power industry has its own unique characteristics. A correct attitude should be based on the spirit of the 14th CPC Central Committee, have a resolute direction and start with reality, differentiate among different situations, and actively push forward. Concretely speaking, all electric power group companies and provincial companies should truly become economic entities that make their own administrative decisions in accordance with the law with responsibility for their own profits and losses, self-development, and self-restraint. They must establish administrative decision-making mechanisms, motivation mechanisms, and stimulation mechanisms, and they should establish the corresponding self-restraint mechanisms and self-accumulation mechanisms. They should assume responsibility for ensuring the value and increasing the value of state-owned property. In particular, they must earnestly study and actively explore effective forms and responsibilities for ensuring and increasing the value of state-owned property and have consistent duties and responsibilities so that they truly foster the superiority of large power grids and state-owned enterprises. All electric power enterprises should do more work on matching reform of the labor, wage, and personnel systems and implement personnel competition for posts. They must apply market principles, make major efforts to advocate the ideology of subsequent work procedures for users, and carry out comprehensive quality management. They must form this type of mechanism to make placing users first and quality first truly become the self-conscious activity of every person. Electric power design, construction, scientific research, manufacturing, economic diversification, and other enterprises must actively take the initiative to enter the market and participate in market competition. They must generate more "Lubuge" [Hydropower Station] impulse-force and create more Nanjing Automation Institutes and Dalian Central Power Plants. There is no room for retreat in this area. Of course, we must also provide them with the necessary conditions.

III. Some Concrete Items of Work and Requirements

A. Continue comprehensive implementation of the principle proposed by the Ministry of Energy Resources of "electric power as the core, a variety of industries, three main pillars, coordinated development"

Practice has proven that this principle conforms to the characteristics of the electric power industry and that it embodies the requirements for development of the socialist market economy, so we should continue resolute and unwavering adherence to it.

1. Electric power capital construction should continue resolutely studying Shandong and northeast China and try to improve quality, shorten construction schedules, and conserve investments to make fully fostering the role of market competition the breakthrough point for more

intensive reform of the capital construction management system and active extension of the proprietor responsibility system, bid solicitation contractual responsibility system, and supervision and management system. It should strengthen management of the entire process from planning to design to construction and establish and perfect responsibility systems at every level. Based on the requirements of the market economy, the quality of capital construction projects must be evaluated by production enterprises.

2. Electric power production enterprises are the ultimate providers of electric power industry services to electric power users. Electric power management work is also first-line work for electric power enterprises to orient directly toward the market and toward users. There is much to be done concerning how to manage and use existing electric power production facilities properly, do good electric power management work, and give electric power users the maximum possible degree of satisfaction. Electric power production enterprises should do good work based on the need to "look inward, exploit potential, reinforce management, improve the two types of results" proposed by the Ministry of Energy Resources. This is particularly true of using transformation of enterprise administrative mechanisms to truly establish pressure and motive power that comes from enterprises themselves and truly establish a strict responsibility system, strict regulations system, and strict and earnest working style to make work to attain safe and civilized production objectives achieve a transition from "wanting me to attain objectives" to "me wanting to attain objectives" and use the attainment of objectives as a foundation for advancing toward becoming socialist first-rate electric power enterprises. Moreover, the guiding ideology proposed by the Ministry of Energy Resources of electric power serving the peasants' lives, agricultural production, and rural economic development has been profoundly accepted in the hearts of the people of all our rural areas, produced excellent social benefits, and spurred improvement in rural power enterprise production and management levels. For this reason, we should continue to focus on work to attain "the three fors" service objectives in rural electric power enterprises and have new ideas and move up to a new stage in the new situation.

3. Employing too many people in electric power enterprises has become a key factor that is affecting enterprise improvement in labor productivity. An important way to improve labor productivity is to reduce personnel. Otherwise, it will be impossible for the overall quality of China's electric power industry to catch up with advanced international levels. The solution lies in intensifying matching reform of the three systems and major efforts to develop economic diversification. At the Dalian Conference in November 1992, the Ministry of Energy Resources proposed the concrete requirements of super-conventional development of economic diversification for electric power, an effort to achieve the struggle objective of surpassing 30 billion yuan in gross income from economic diversification, and a decision to have one-half of the personnel become involved in economic diversification (including tertiary industry). In regard to this, we must certainly stand at the heights of enterprise development strategies, deepen our understanding, and make them hard tasks to be completed. Enterprises themselves must rely on all types of channels to raise capital for economic diversification. At the same time, we must think of ways to help electric power, especially hydropower, construction enterprises find loans and capital for changing production in economic diversification to spur a transformation of the administrative structure in the electric power industry.

4. We must pay extremely great attention to major efforts to develop S&T and education. Modern S&T progress continually raises the extent of automation in the electric power industry, which means that the requirements are ever-higher for the quality of personnel, not the quantity. For this reason, we must make a major effort to develop electric power S&T and education, and continually improve the technical professional quality of personnel and the overall quality of enterprises. China's electric power enterprises must certainly have a strategic view, thoroughly renew concepts, and spend their own money and effort on developing science and technology and improving the quality of personnel.

Reform of the S&T system has resulted in scientific research workers in electric power scientific research units and electric power institutions of higher education under the jurisdiction of the Ministry of Energy Resources and all grid and provincial laboratories and research institutes becoming the vital force on the main battlefield of technical progress in electric power. This staff should continue to adhere to the spirit of stabilizing and reinforcing unity and opening up everywhere in continuing intensive reform of the S&T system and make greater contributions to accelerating development of the electric power industry in the areas of technical equipment, attacking key S&T problems, technology development, extension and application of S&T achievements, international S&T cooperation, technical standards in the electric power industry, technical supervision, technical information, consulting services, and so on. All electric power enterprises should also take the initiative in being concerned with, supporting, and relying on this S&T force and propel China's electric power S&T to a new level.

We must carry out additional reform of the electric power educational system. Make a great effort to spur electric power institutions of higher education to go further in establishing the self-development mechanisms required for taking the initiative in adapting to and serving electric power production and construction, and mechanisms that fully spur electric power enterprises to actively participate in broadly supporting and properly running electric power institutions of higher education. We must change the situation of excessive involvement of the Ministry of Energy Resources in the internal affairs of institutions of higher education, speed up reform of the internal management system in electric power institutions of higher education, and ensure that institutions of higher education truly become entities that manage their own educational affairs and have the status of independent legal persons.

To meet the personnel quality needs of a modern electric power industry, it will be necessary to open up the educational levels of electric power technical schools and technical colleges and run them as a unified medium-level professional technical educational level so that after graduation personnel can serve as either workers or cadres. We must continue to focus on job position training and continuing education. We must actively create the conditions to implement simulation training for large generator operating personnel and power grid dispatching personnel.

To make a major effort to develop S&T and education, we must take action to establish an S&T and educational fund system.

B. On an administrative responsibility system

The time has already come and gone during 1991 and 1992 for electric power industry enterprises to implement contractual responsibility in a rolling fashion. According to the relevant provisions in the "Regulations", they should start implementing a new property management responsibility system in 1993. Through research by the relevant departments and the views of the Ministry of Energy Resources for a new round of administrative responsibility systems, the first thing is to start in 1993 in having the five large multi-provincial power grids have their various enterprise groups directly match up with the state so that the Ministry no longer has unified responsibility. The manufacturing enterprises under the jurisdiction of the Ministry's Machinery Manufacturing Bureau should have their machinery bureaus match up with the state. The six provincial companies under the Ministry's jurisdiction should in principle match up directly with the state, and if some relevant departments desire unification with the Ministry they can also be the responsibility of the Ministry. Second, support enterprises in adopting a variety of models to clarify enterprise financial relationships and property management arrangements to the state. Third, during the process of enterprises negotiating with the relevant state departments, the Ministry of Energy Resources will assist enterprises in doing good work to open channels in accordance with state policies.

Construction enterprises will temporarily be the responsibility of the Ministry in implementing a contractual responsibility administrative system with contractual responsibility for profits and taxes to the state. All construction enterprises must implement an internal economic contractual responsibility system at different levels and in different forms. The design units under the two central planning academies will be the responsibility of the two central academies through the Ministry in having contractual responsibility to the state.

C. On expanded trial point work for electricity price reform and reappraising the stocks and assets of enterprises

The basic goal in intensive reform of electricity prices is, in accordance with the need to establish a socialist market economy as a foundation, to gradually straighten out the electricity price structure and electricity price management system, unify power grid electricity selling prices, establish benevolent cycle mechanisms for development of the electric power industry, and spur accelerated development of our overall national economy. At present we must focus on formulation of a unified electricity price policy and price setting principles and methods, and gradually establish mechanisms for setting electricity prices based on costs, taxes, and reasonable profits. Starting on 1 January 1993, all electric power construction projects, including those with loans from the central government, implemented an electricity policy for the repayment of principle and interest, reformed additional prices for fuel shipment and formulated new listed electricity prices, actively implemented electricity prices for peaks and valleys and for wet and dry seasons, and unified electricity selling prices. All units must focus on electricity price reform work, strengthen and consolidate electricity price management forces, coordinate closely at all levels, cooperate in action, and intensify electricity price reform.

As for work to reappraise the stocks and assets of enterprises, with State Council approval the North China Integrated Electric Power Company will serve as one of the six central enterprises for the first-phase trial period for which trial point work was begun during 1992 to explore experience for expansion of the trial points. Based on the deployments made by the State Council's Enterprise Stocks and Assets Reappraisal Leadership Group, expanded trial points for reappraisal of enterprise stocks and assets will be undertaken throughout the electric power industry during 1993. This is extremely important for transforming enterprise mechanisms and establishing new state-owned property management mechanisms to adapt to the requirements of the market economy, and all units must strengthen leadership and conscientiously focus on this.

At the same time, all units should make good preparations in accordance with the requirements by the Ministry of Finance to start implementation of enterprise general financial rules and accounting standards on 1 July 1993 for comprehensive implementation of enterprise financial and accounting reform.

D. On capital construction in electric power construction enterprises and other questions

We must rely on reform and policies and actively create the conditions to solve the capital construction problems of construction enterprises, especially hydropower construction enterprises. Most hydropower construction enterprises do arduous work for years in deep mountain gorges and valleys and they have contributed their youth and their lives to the development of China's hydropower industry and established brilliant military successes for the state. We must focus on dealing with the basic living conditions and troubles back at home of the state's key builders as a key project. Moreover, to better and more quickly develop China's electric power industry, we also must rely on reform and policies to solve problems in electric power construction enterprises such as profit rates on their value of output that are too low, an inability to replace technical equipment, the lack of development

reserve strengths in enterprises and an inability to participate in equal competition in markets, and so on. We must focus on studying and resolving the problem of insufficient preparatory funds for electric power construction and an inability to recover them, and on the problem of small-scale electric power construction that cannot be coordinated with development of the primary industry.

Ministry Re-Established To Head Up Coal Sector

40100087A Beijing CHINA DAILY in English 4 Jun 93 p 1

[Article by staff reporter Chang Weimin]

[Text] China's Ministry of Coal Industry was officially re-established yesterday.

Wang Senhao, Minister of the Coal Industry, outlined tasks for the next 3 years, saying that by 1995, a firm foundation would be laid for the industry's continuous development under the new market economy.

The industry, of which State-owned mines constitute the backbone, is faced with meeting rising market demand, while seeking good economic results.

The industry employs some seven million people and produces 1.1 billion tons of coal a year. State-owned mines amount to about 50 percent of the total.

The industry is being re-tuned from its former centrally-planned course into the new market-oriented mechanism in step with the country's reform programme.

Wang made his remarks at a ceremony in Beijing to mark the official re-establishment of the ministry.

The former ministry of coal industry was abolished and replaced by the China Coal Corporation in the early 1980s. But in the plenary session of the National People's Congress held in March this year, it was decided to dissolve the coal corporation and re-establish the ministry, as a part of the government restructuring programme.

Wang said he expects the industry, which has been inefficient for years due to government-controlled, artificial low prices of coal, will be a profitable sector in 3 years.

The central government has already allowed the price of coal produced by several mines to float at market levels. By 1995, the price of all coal to be produced by key State-owned mines will be liberalized, Wang said.

Meanwhile, efforts will be made to accelerate the reforms of the current pricing system, he added.

In 1992, 1.08 billion tons of coal were mined, which constituted 74 percent of the energy produced by the country that year.

Coal will continue to be the mainstay of China's energy source at least until the year 2000, experts said.

The national economy is expected to grow at 8 to 9 percent in the coming years. Annual demand for coal will rise to 1.4 billion tons by 2000, Wang pointed out.

Therefore, macroeconomic planning should be improved, resource exploration beefed up, and more efficient mines built to guarantee continuous increases in production, Wang said.

A hundred new high-yielding mines will be opened in the near future, Wang revealed in an article published in May.

Wang urged his men in the ministry to get rid of the work style that suited central planning and build new styles in accordance with the requirements of a market economy.

The ministry will not interfere in enterprises' businesses. Instead, Wang said it will provide services, such as macro-planning and co-ordination, to enterprises.

The ministry will help mines deal with difficulties. However, the minister said some hopeless mines—producing "low-quality coal at very high cost"—will be closed.

Big Foreign Investment Predicted for Electric Power Sector

936B0077A Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 7 May 93 p 1

[Article by reporter Zhou Zongmin [0719 1350 2404]]

[Text] Beijing, 5 May (XINHUA)—Minister Shi Dazhen of the Ministry of Electric Power Industry said on 5 May that China will make a major effort to get foreign investments for developing the electric power industry to make up for insufficient investments in electric power construction within country.

He said, the ratio of foreign investments in China's electric power construction will be increased from the present 1/10 to 1/5 in the next 5 years. China will step up the pace of importing advanced foreign electric power facilities to replace old facilities an many power plants.

Shi Dazhen made this announcement at the first news conference held after the establishment of the Ministry of Electric Power Industry.

The new minister expressed his welcome to independent foreign commercial funds or joint ventures with China for electric power.

It was learned that some of China's coastal zones already have foreign commercial joint ventures or have entered into electric power projects with independent foreign commercial funds, such as the Guangdong Daya Bay nuclear power plant, Guangdong Shajiao B power plant, and Jiangsu Ligang power plant.

Shi Dazhen said that in view of the shortage of national investments, using foreign funds is a good way to speed up the development of China's electric power industry.

He said China will raise the current price of electricity, and work to get on track with the international electric power market as quickly as possible, to open a "window of opportunity" for investments in China's electric power industry. Shanghai Pudong, and the Guangdong and Shandong coastal areas will be the first to open up the price of electricity this year.

In 1979, China began to use foreign funds to develop the electric power industry, has raised and used over 11 billion U.S. dollars in foreign funds to date, and has reached agreements on 53 projects including, thermal electricity, hydropower, nuclear power, and power transmission projects for a total power capacity of 42,000MW.

From now until 1996, China plans to list 21 electric power projects as loan projects.

Shi Dazhen said that in the next 5 years, China plans to increase its installed capacity by 85,000MW to relieve the current power crunch.

China's total installed capacity is now 165,000MW, and the annual output is 742 billion kWh, ranking fourth in the world.

Minister Shi revealed that in the 1990s China will appropriately develop nuclear power, and in the 21st Century China will have a sizeable foundation for large-scale development of nuclear power.

State Council Established Three Gorges Construction Commission

936B0074C Chengdu SICHUAN RIBAO in Chinese 3 Apr 93 p 1

[Article by Central People's Broadcasting Station reporter Liu Zhenmin [0491 2182 2404] and XINHUA reporter Ji Bin [1213 2430]]

[Text] Beijing, 2 Feb (XINHUA)—The first session of the State Council Three Gorges Construction Commission took place at Zhongnanhai on 3 April. State Council Premier Li Peng took charge of the meeting.

In order to guarantee that Three Gorges construction goes smoothly, the State Council decided to form the Three Gorges Construction Commission with Premier Li Peng as Director; Vice Premier Zou Jiahua, State Councillor Chen Junsheng and Gua Shuyan, Gu Zhijie, Xiao Yang, and Li Boning as Deputy Directors, CPPCC Vice Chairman Qian Zhengying as Consultant, and the body of the commission to be made up of pertinent State Council Department officials. This commission is the high level policy making organization for the Three Gorges project, with offices set up to handle the routine tasks of Three Gorges construction; a Three Gorges Population Relocation Bureau responsible for planning the relocation effort, and implementation of its provisions and its supervision. The China Chang Jiang Three Gorges Engineering Development Corporation was also established to be an independently managed economic entity responsible for its own profits and losses, and fully responsible for the Three Gorges construction and management.

The conferees heard and discussed Guo Shuyan's review of the situation concerning the work on the construction facilities for the Three Gorges project, and Li Boning's report on the situation with regard to the Three Gorges reservoir relocation effort. After the "Resolution on the Construction of the Chang Jiang Three Gorges Project" was passed in March 1992 by the Fifth Session of the Seventh NPC, the State Council twice convened Premier's office meetings to study Three Gorges project construction issues, and in November, Premier Li Peng lead officials of relevant departments along the river from Chongqing for on-site inspections, and took charge of a Three Gorges construction meeting in Wuhan, and in accordance with arrangements laid down by the State Council, positive construction preparations were made by engineering organizations, and good progress was made in gaining experience at the relocation test site.

At the meeting, Li Peng emphasized that the Three Gorges is a project that spans the centuries, with good multipurpose benefits that will serve generations to come. Completing this project smoothly will show the world China has the will and the capability to do the job right before the eyes of the world. He said that the broad masses must be allowed to understand the necessity and feasibility of the Three Gorges project, and their support is the key to its success.

Li Peng said the NPC's "Resolution on the Chang Jiang Three Gorges Project" must be carried out to the fullest, and the main object of the present effort is to make good preparations, get the construction preparations organized, and especially the initial design and inspection; there must be new avenues for funding, and methods for funding the Three Gorges construction must be found; not only must the funding be well done, but careful calculation, strict budgeting, sound management and use of funds must be skillfully accomplished. In order that it be appropriate to the new socialist market economy the Three Gorges project must employ international practices and methods, and a project proprietary responsibility system must be put into effect.

Zou Jiahua, Chen Junsheng, and other members of the Three Gorges Project Commission attended the meeting of 3 April.

New Development Stage for Electric Power and Electric Power Systems

936B0068 Beijing ZHONGGUO DIANLI [ELECTRIC POWER] in Chinese Vol 26, No 3, 5 Mar 93 pp 3-7, 33

[Article by Zhang Fengxiang [1728 7685 4382] of the China Electric Power Enterprise Union: "A New Stage in the Development of China's Electric Power Industry and Power Grids"]

[Text]

I. A New Stage in the Development of the Electric Power Industry

In the 10 years since reform and opening up, China's electric power industry has developed quickly, especially in the last 5 years during the Seventh 5-Year Plan (1986-1990) when implementation of the policy of raising capital through multiple channels to develop electric power led to a takeoff in development of the electric power industry. In 1991 China's total installed generating capacity increased to 151,473MW and yearly power output reached 678 billion kWh. China increased its installed generating capacity by 50,837MW during the Seventh 5-Year Plan

and generated an additional 211 billion kWh of electricity, which were average yearly growth rates of, respectively, 9.6 percent and 8.6 percent. The speed and scale of growth in the electric power industry during this period are unprecedented in the history of China and seldom seen in the world. China ranks fourth in the world in both installed generating capacity and power output and we have entered the ranks of the big electric power nations.

In 1980, China had just 34 thermal power generators larger than 200MW that accounted for 15.7 percent of our total thermal power installed generating capacity. This number grew to 194 in 1991 and they accounted for 41.5 percent of our total thermal power installed generating capacity. The capacity of the largest thermal power generator at present is 600MW and the capacity of the largest hydropower generator is 320MW. China also made significant achievements in power grid construction. At the end of 1991 China had 474,000 kilometers of power transmission lines at 35 kV and higher and the total length of our 110 to 500 kV power transmission lines has now grown to 209,000 kilometers. Our first 500 kV DC power transmission line was completed and placed into operation in 1990 to link the two big Central China and East China Grids and form a large mixed AC-DC integrated grid.

Seven multi-provincial and multi-autonomous region regional power grids have now formed on the Chinese mainland in northeast, north, east, central, northwest, southwest, and south China. Four of the grids, in northeast, north, east, and central China, have installed generating capacities greater than 20,000MW and have basically completed a 500 kV ultrahigh voltage power transmission and transformation network. Among the independent provincial grids, Shandong's has the largest installed generating capacity at more than 9,000MW and together with the seven multi-provincial grids forms China's eight large power grids. The Three Gorges Hydropower Project has now been included in the state's 10-year plan and will have an installed generating capacity of 17,680MW. When it is completed it will link together the central, east, and southwest China grids.

The development and application of new technologies and new equipment in power grids is now changing the face of China's electric power system. Big 300MW and 600MW thermal power generators, large 300MW and bigger hydropower generators, new types of static reactive compensation devices, new types of microcomputer automatic relay protection and safety devices, and new types of excitation regulation and prime mover regulation devices have now been placed into actual operation. The 900MW nuclear power generators at Daya Bay Nuclear Power Plant and large pumped-storage power plants at Shisanling (800MW), Conghua in Guangdong (1,200MW), and so on have entered the construction phase.

The above situation shows that the development of China's electric power industry has now entered a new stage of large power grids, large generators, ultrahigh voltages, and AC/DC.

II. Development Principles for the Electric Power Industry

A. The main problems in development of the electric power industry at the present time

1. An inappropriate development speed

During the Seventh 5-Year Plan, industry and agriculture grew at an average rate of 10.01 percent, energy resources at 3.92 percent (an elasticity coefficient smaller than 0.5), and electric power increased at 8.6 percent ($K>1$), and we had an installed generating capacity shortage of about 19,000MW. In 1989 we had 308,000MW in power-consuming equipment capacity and 126,000MW in power generation equipment, for a ratio of 1:2.48 between power generating and power-consuming equipment (a rational ratio is 1:2).

2. Low electricity prices

We lack a self-accumulation and self-development capability and rely on outside investments to sustain development (fixed assets account for ¼ of China's industry, value of output only accounts for 0.9/10).

3. Energy shortages and a large proportion of self-consumed energy resources

Energy consumption was 9.6 tons of standard coal per 10,000 yuan in value of output (4 to 5 times that in the West), the power use rate in power plants was 6.3 percent, and coal consumption to supply power was 430 grams [per kWh] (327 grams in the former Soviet Union, 331 grams in the former West Germany).

4. A low proportion of primary energy resources used to generate power

The proportion of primary energy resources used to generate power in the West is 35 to 45 percent but just 22.7 percent in China (total coal consumption in 1989 was 969 million tons of standard coal, with 220 million tons being used to generate electricity). It has been more rational in recent years, with 50 percent of new additional coal output being used to generate electricity.

5. Slow growth in hydropower

The development rate of hydropower resources is just 9.2 percent. The proportion of investments in hydropower has continued to drop. During the Sixth 5-Year Plan we placed 6,090MW of hydropower into operation, equal to 29 percent of the total amount placed into operation. During the Seventh 5-Year Plan we placed 9,640MW of hydropower into operation, equal to just 19 percent. The amount invested dropped from 21.4 percent in the Sixth 5-Year Plan to 16 to 18 percent.

6. A reduction in the proportion invested in power grid construction

Investments in power transmission and transformation accounted for 20.9 percent of total investments during the Sixth 5-Year Plan and 19.3 percent during the Seventh 5-Year Plan. During the Sixth 5-Year Plan, the amount of lines we built per 10,000 kW was 22.47 kilometers at 35 kV, 11 kilometers at 110 kV, and 9.85 kilometers at 220

kV. During the Seventh 5-Year Plan this dropped to 12.7 kilometers at 35 kV, 98 kilometers at 110 kV, and 6 kilometers at 220 kV.

7. Few large generators, low single unit capacities

We had 2,521 generators 6MW and larger in 1989 with a total capacity of 105,000MW. The average was 41.7MW per unit. The average capacity of new generators placed into operation during the Seventh 5-Year Plan was 140MW. Generators 200MW and larger accounted for 35.7 percent of our capacity and those 100MW and smaller accounted for 39.5 percent, which has resulted in coal consumption remaining high. We have 20,000MW of thermal power generators 50MW and smaller that must be abandoned during the next 10 years

8. A low proportion of heat and power cogeneration

Heat supply generators as a proportion of our thermal power installed generating capacity declined from 20 percent in 1965 to 10 percent in 1980, 8.8 percent in 1985, and 9.2 percent in 1989 (8,489MW).

9. Rising investments in electric power

The investment per kW at power plants reached 3,000 yuan (it was 1,746 yuan in 1985).

10. Rising production costs

The cost per ton of coal was 53.5 yuan in 1989. The selling price of electricity (yuan per 1,000 kWh) was 32.66 yuan in 1985, 47.11 yuan in 1986, 52.07 yuan in 1987, 59.62 yuan in 1988, 73.95 yuan in 1989, and 83.9 yuan in 1990.

11. Serious debt, declining profit rates on capital

The profit rate on capital was only 3.7 percent in 1989. The total amount of capital construction loans in the electric power industry in 1989 was several 10 billion yuan. Calculated at the present 3.7 percent profit rate on capital, this is still insufficient to pay the interest and the price must be readjusted.

B. Basic principles for development of China's electric power industry

1. Develop the electric power industry under the guidance of the basic principles of developing the energy resource industry

The basic principles for the development of China's electric power industry are: combine development and conservation, focus energy resource development on electric power, make coal the foundation, make major efforts at developing hydropower and appropriate development of nuclear power, actively develop petroleum and natural gas. Make major efforts to conserve electricity, conserve oil, and conserve coal. Extend heat and power cogeneration, develop surplus heat utilization. Continue to implement the policy of substituting coal for oil, increase energy resource utilization rates, reduce environmental pollution.

2. The pace of development of the electric power industry must be adapted to the pace of development of our national economy

To reverse the power shortage situation, the pace of development of the electric power industry during the next 10 years must be adapted to the pace of development of our national economy. The elasticity coefficient for electric power as a ratio to the rate of growth in our gross value of industrial and agricultural output should be greater than 1. Based on our primary energy resource plans, energy resources must increase at an average annual rate of about 3 percent over the next 10 years. Making arrangements based on an elasticity coefficient of 0.5 for primary energy resources and a growth rate of about 6 percent in the gross value of industrial and agricultural output, the growth rate for electric power should be 7 percent, so its elasticity coefficient is 1.16. This is both necessary and possible.

3. Place conservation of energy resources and reduce consumption in an important position

One, adopt high parameter and high efficiency large generators. With the exception of expanding some old power plants and continuing to use 200MW and smaller generators because of other restricting conditions, we should start in the Eighth 5-Year Plan using subcritical and supercritical pressure generators with unit capacities of 300MW and larger in all newly-built power plants. We should try to eliminate as many as possible of the more than 20,000MW in moderate and low pressure generators and generators that have exceeded their service lives. Prohibit the construction of 25MW and smaller steam turbine generators in the power supply regions of large power grids. Small thermal power plants built in regions that have coal but that do not ship it out and in regions not reached by power grids should try as much as possible to burn coal gangue, poor-quality coal, coal that is in the process of being washed, coal slurry, and other low heat value fuels.

Two, actively develop heat and power cogeneration and centralized heat supplies. In the future, all enterprises and units that have a total heat supply capacity of more than 10 to 20 tons/hour and that have stable heat loads and yearly utilization times of more than 4,000 hours should try as much as possible to arrange for heat and power cogeneration. Those existing small condensed steam thermal power plants and small boiler heat supply systems that have the proper conditions should be upgraded to heat and power cogeneration or gradually eliminated. We should develop thermal power plants (including cogeneration plants) that burn low heat value fuels (including coal gangue, coal in the process of being washed, and coal slurry) in mining regions to conserve coal.

Three, try in very possible way to reduce self-consumption of energy resources. Reduce coal consumption, electricity use in power plants, and line losses. Strengthen reservoir management at hydropower stations, operate in strict accordance with dispatching charts, and strive to reduce water consumption.

4. Build large pit-mouth power plants, work on balancing coal transportation and power transmission

The focus of power plant construction during the next 10 years should be on building large pit-mouth power plants and harbor power plants to shift from transporting coal to

transmitting electricity. This is particularly true of local construction of power plants for low heat value lignite.

5. Foster the advantages of hydropower, accelerate hydropower base area construction

Accelerating hydropower construction to reduce coal supply shortages and reduce environmental pollution is one of the basic strategies for developing China's energy resource industry. The development of hydropower should receive the same sort of preferential conditions as development of petroleum, coal, and other primary energy resources through formulation of the corresponding policies and measures to increase investments, improve hydropower development conditions, and accelerate hydropower construction. China has 378,000MW of developable hydropower capacity but only about 9 percent has been developed at present.

We must focus on the following points in the area of the deployment of hydropower construction:

One, focus on developing the upper reaches of the Huang He, the trunk and tributaries of the Chang Jiang, the Hongshui He Basin, the Lancang Jiang, and other large hydropower base areas.

Two, actively build medium-sized hydropower stations in regions with shortages of energy resources, good hydropower resource conditions, and superior technical economics indices, and the state should use its discretion in providing some low-interest loans.

Three, power grids with large system peak-to-valley differentials should build several pumped-storage power stations to resolve system peak regulation problems and improve the quality of electricity supplies.

In addition, we should also focus on rebuilding, expanding, renewing, and upgrading existing hydropower stations. Expend 10 years of efforts to increase the degree of development of China's hydropower from the present 9 percent to about 18 percent.

6. Place nuclear power construction in an important position

Developing nuclear power is an important aspect of solving China's energy resource problems in the future. Because of the very high technical, safety, and administrative requirements of nuclear power construction, nuclear power is a comprehensive embodiment of a country's national strengths and its capital density is very high, so we must place nuclear power construction in an important position. During this century, concentrate forces on developing and building 600MW pressurized-water nuclear power plants, gain an understanding of manufacturing technologies, basically achieve our own designing, deal properly with safety, reliability, and economy, and strive for a shift to domestic production, standardization, and batch production. In addition, we must study and build a nuclear fuel system at a suitable scale for pressurized-water reactors, including geology, metallurgy, concentration, nuclear fuel elements, and reprocessing plants. Lay a foundation for accelerated development of nuclear power in the next century.

7. Speed up construction of key power transformation projects, do good upgrading of urban and rural power grids

To adapt to the requirements of pit-mouth power plants and large-scale hydropower base area construction, we must make good arrangements for power grid construction.

Besides reinforcing construction of 500 kV key power transmission and transformation projects, we should also reinforce construction of 220 kV and lower power transmission and distribution projects and construction of reactive, communications, and other matching projects. We must reinforce construction of urban grids and rural grids, increase the reliability of power supplies, and reduce line losses.

8. Focus on environmental protection, actively prevent pollution of the environment

Actively adhere to the principle of "focusing on prevention, comprehensive control" for rational deployment and rational utilization of resources. Electric power new construction and expansion projects should achieve the "three things at the same time", attain pollutant discharge standards formulated by the state or local areas, and accelerate pollution control in old enterprises. Increase comprehensive control levels and reutilization rates for waste water from the electric power industry, build thermal power plant desulfurization demonstration projects, stop discharging ash into rivers, lakes, and other bodies of water. To conserve water use, gradually expand air cooling towers and dry ash removal in regions with water shortages.

9. Focus on and do good work in rural area electrification construction

Rural electrification should be adapted to the overall situation in development of our national economy and reinforce the guiding ideology of serving agriculture. Rural electric power construction must be coordinated with rural development plans and focus on the main topic of serving rural economic development and meeting agricultural production and peasant household electricity use requirements. We must match up comprehensive development in poor old revolutionary base area, minority, and frontier regions, and focus on solving the power supply problems of counties that have no electricity supplies and densely populated regions that are not supplied with electricity. We must conform to the principle of "adapting to local conditions, supplementation by multiple types of energy resources, comprehensive utilization, concern for results," and adapt to local conditions in construction of wind-powered and solar-powered electricity generation in frontier rural areas and coastal islands to resolve difficulties with conventional energy resources and solve the power use problems of regions without electricity or with electricity shortages.

10. Rely on S&T progress, develop educational activities, improve personnel quality

Fully foster the role of S&T as the first force of production, increase investments in S&T. Expenditures on S&T development in the electric power industry as a proportion of its gross value of output have increased from 0.3 percent to 0.8 percent. Spur a true shift in electric power construction onto the track of reliance on S&T progress and improving labor productivity and economic results. The focus of the development strategy for electric power S&T during this century is: develop new electric power technologies and digest and absorb them, develop large capacity, high parameter, high efficiency thermal power generators and supercritical parameter generators; study and gain an understanding of construction technologies for building 3,000MW and larger thermal power base areas; complete coal-water mixture, circulating fluidized-bed, and coal gasification combined cycle experimental power plants; develop combustion technologies for high-sulfur coal, low volatility anthracite coal, low heat value coal, high water content coal, low ash melting point coal, coal in the process of being washed, and so on, and study and resolve power plant coal transportation, ash removal, water conservation, and environmental protection technologies; do research on ultrahigh voltage large capacity long-distance power transmission and transformation technologies and power transmission and transformation technologies for an even higher voltage grade than 500 kV, increase automation levels in power grid dispatching; study and gain an understanding of design and construction technologies for high dams, deeply-capped long tunnels, and large-span plant buildings; do research on 500 to 800MW large water turbine generators and high head, large capacity pumped-storage generators; organize attacks on key S&T problems for the Three Gorges hydropower project; develop new technologies for hydropower, shorten construction schedules, reduce construction costs, and reduce inundation losses. We must also train a group of S&T personnel at international levels and build several electric power scientific research, experiment, and testing base areas at international levels.

III. Primary Technical Problems Facing Power Grid Development

A. Safety questions in long-distance power transmission

China's coal resources are distributed mainly in Shanxi and Inner Mongolia in north China, in Shaanxi and Ningxia in northwest China, and other areas. Our hydropower resources are concentrated in southwest and northwest China. However, east China and the coastal region are the economically developed regions with more concentrated power use loads. Thus, the development of large pit-mouth thermal power plants and hydropower stations generally encounters the question of grid stability raising from long-distance power transmission.

B. Operational problems in integrated power grids

As mentioned previously, China now has seven multi-provincial regional grids and several provincial grids. In certain regions, the initial linking of regional grids and provincial grids was done via relatively low-voltage (such as 220 kV) circuits to make weakly integrated grids. This has resulted in the relationships among several provincial grids within the regional grids being somewhat weak. There are problems in the operation of weakly integrated systems such as low-frequency oscillations in connecting lines, the elimination of non-standard power fluctuations, power control, integrated grid frequency regulation, and so on. In addition, after the Ge-Shang [Gezhouba-Shanghai] DC power transmission project linking the two big Central China and East China Grids was placed into operation, there were problems like interaction of the DC power transmission system's control, regulation, and protection and AC-DC system dispatching operations, making use of the fast regulation characteristics of the DC system to improve the stability of the AC system, and so on, all of which require further resolution through experimental research and the accumulation of operating experience. The 17,680MW in installed generating capacity at the Three Gorges Power Station will transmit power in a mixed AC-DC arrangement to the Central China, East China, Sichuan, and other grids. Thus, research on these high technologies is even more important and urgent.

C. The problem of reactive voltage regulation in power grids

Power grids have insufficient reactive compensation capacity, voltage levels in certain regions with central loads are too low, and stability levels are poor. Some power plants transmit reactivity over long distances with substantial losses. There is a lack of voltage regulation measures, so voltages are too low during peak loads and too high during valley loads. These reactive voltage regulation problems remain to be solved.

D. The problem of placing large generators into operation

In China at present and for a considerable amount of time into the future, the capacity of our thermal power generators will be mainly 300MW and 600MW. When large thermal power generators are placed into operation, torsion vibration of the axis systems of generators caused by abnormal working conditions in power grids may damage the generators. They can also cause frequency, voltage, and other stability problems in grids with relatively small capacities.

E. The problem of peak regulation in power grids

Our installed hydropower generating capacity does not account for a large proportion in China's power grids. In 1991, for example, hydropower accounted for only 4.6 percent in the North China Grid and 10.6 percent in the East China Grid. Moreover, the peak regulation capabilities of thermal power generators are usually relatively poor, which has made peak regulation problems extremely acute in many grids.

F. The problem of harmonic wave pollution in power grids

The development of electrified railroads and other rectified, asymmetrical, non-linear, and non-sine wave loads and the utilization of large numbers of household appliances have resulted in increasingly serious harmonic wave

pollution problems in China's power grids. Some have already resulted in incorrect operation of protection equipment, endangering safe operation of the grids and causing losses to electric power departments and users.

G. The problems of power grid communications and dispatching automation

Large generators and large grids have been established in a preliminary fashion, but grid communications and dispatching are still backward. They have developed more quickly in the past 10 years, but technical levels are still rather low and require improvement.

IV. Problems That Require Study In Power Grid Development

To adapt to the further development of China's power grids, current and future research on power grids should concentrate forces on the following areas.

A. Macro decision-making for grid development

Power grids must implement optimized planning and rational utilization of energy resource to provide scientific data for decision-making by leading departments regarding grid development.

We must apply systems engineering methods to reinforce research on power economics, planning optimization, and scientific management. Based on the energy resource policy for the period prior to the year 2000 of coal being the dominant factor in our power generator energy resource structure with major efforts to develop hydropower and appropriate development of nuclear power, do good electric power system development planning and make rational arrangements of power source deployments and power grid structures, and, based on the requirements of grid development, use the economy and possibility of grid integration to consider and decide upon the times and arrangements for grid integration to achieve rational utilization and comprehensive utilization of all types of power generation energy resources.

The content of plans should include: optimization of power source development sequences, distribution of basic loads, mid-range loads, and sharp peak loads among various power sources, and changes in functions over time; electric power and power output equilibrium optimization, increased load rates, guarantees of sufficient reserve capacity and peak regulation capacity; carry out optimization of operating modes based on power output and generation structures, power use load requirements, and power use structures; optimize large regional primary grid structures and integrated grid structures based on the development of large hydropower stations and thermal power plants.

B. Key technical questions

1. Comprehensive technical economics analysis and operational dispatching tactics for integrated power grids: 1) Economic assessment of integrated grids; 2) Safe control and comprehensive accident handling in integrated grids.

2. Power grid safety and stability analysis and stability control technology: 1) Safety stability analysis and control during and after accidents in integrated grids; 2) Safety stability control in grid linkage circuits; 3) Graded control tactics in large grids; 4) Multi-generator system frequency and voltage instability control methods.

3. Problems in placing large generators into operation: 1) The problem of torsional vibration fatigue in the axis systems of large steam turbine generators caused by grid breakdowns and operations; 2) The problem of asynchronous vibrations in the axis systems of large steam turbine generators induced by the operation of DC power transmission or conversion equipment; 3) Large generating unit safe operation monitoring technologies; 4) The problems of frequency and voltage control when large generators are placed into operation in power grids with relatively small capacities.

4. Problems of AC-DC grid operation: 1) Analysis of the interaction of AC-DC systems; 2) Ways to use DC regulation to increase stability and other aspects of the operating performance in AC systems; 3) Harmonic waves and resonance created by DC power transmission and measures to eliminate them; 4) Research on multiterminal AC power transmission application technologies and their prospects.

5. Matching operation and control of nuclear power, pumped-storage, and thermal power

6. Reactive compensation equipment and reactivity optimization technologies: 1) Research and application of controlled silicon-type and self-saturation type reactive compensation devices; 2) Optimized configurations for reactive compensation and voltage regulation measures.

7. Applications of series connected capacitative compensation in ultrahigh voltage power transmission.

8. Applications of computers in power grids: 1) Microcomputer stability monitoring and control devices; 2) Microcomputer automatic relay protection and safety devices.

C. Research and software development for electric power system analysis and planning methods

1. Perfection, application, and commercialization of existing electric power system analysis and planning.

2. Development and establishment of electric power system analysis and planning databases.

3. Development of new digital emulation software for electric power systems and further developments in numerical and physical emulation technologies.

V. Development of Power Grid Communications and Dispatching Automation Technologies

To ensure safe and economical operation of power grids and improve the reliability of power supplies, they must be configured with a set of secondary systems that are adapted to the primary system, including automatic relay protection and safety devices; equipment for automatic dispatching monitoring and control systems and weather monitoring systems centered on computers for correctly

fostering normal grid operation and anticipating and dealing with accidents. Modern grids must also have a relatively integral communications system to serve the various systems described above and for grid operation management. Automatic safety and stability devices for electric power systems and dedicated communications systems for automatic dispatching systems and electric power systems have now become an inseparable part of modern power grids and one of the "three main pillars" on which modern grids depend.

Preventing the expansion of grid accidents in modern complex power grids can no longer be dealt with through simple component protection. It requires the installation of automatic safety devices. To protect grid stability, besides eliminating breakdowns as quickly as possible, there must also be rapid generator cutouts on the power transmission side to cut out the corresponding electric power loads on the power receiving side.

Thus, modern electric power systems are gradually adopting various types of automatic devices related to guaranteeing safe and stable system operation. Examples include low frequency load reduction, generator vibration cutout, vibration tripping, remote generator cutout, load cutout, electrical braking, main steam valve closing, and so on.

The regional stability control devices developed in China have now been placed into operation in the Western Liaoning system in northeast China. The devices are composed of microcomputers and utilize off-line computing and on-line transient model differentiation methods. Placing this system into operation has improved the Western Liaoning grid's transient system and prevent overloading of the circuits and other equipment.

During the past 10 years, China has established in an initial fashion a dedicated national electric power communications network for most grid bureaus and provincial bureaus, and 28 provinces and municipalities have establish dedicated microwave circuits for electric power.

In the area of dispatching automation, during the past 10 years dispatching in most grid and provincial bureaus has achieved to varying degrees grid safety monitoring functions. It is the data collection and safety monitoring and control system (SCADA). The four big East China, North China, Northeast China, and Central China grids have imported power grid dispatching automation systems at advanced world levels of the early 1980's and have achieved preliminary safety monitoring and control and automatic power generator control functions. This is the SCADA + AGC/EDC system. It can also be developed into an energy management system (EMS). A pyramid of real-time data communications networks have now basically been formed among dispatching computers at all levels on a national scale.

During the Eighth 5-Year Plan and for a longer period into the future, dedicated electric power communications networks will gradually develop into mixed data and modeling communications networks and actively expand the data plane in the mixed data and modeling communications network and make a gradual transition toward a comprehensive data network and comprehensive service data network. Further perfect transmission networks and reliable data transmission channels to provide the electric power system safety and stability control and automated power grid dispatching systems required for modernized grids.

Planning objectives for the automation of grid dispatching mainly involve consolidating and perfecting EMS in the four large grids as a basis for establishing a state electric power dispatching center dispatching automation system to form a remote computer data transmission trunk network among national dispatching and large grid and independent provincial dispatching and among grid dispatching and the associated provincial dispatching. Most provincial-level dispatching will achieve SCADA functions. Prefectural dispatching and county dispatching will achieve SCADA functions to varying degrees and will achieve load control in large and medium-sized cities. Power grid dispatching automation systems will achieve real-time monitoring and control and level-by-level information transmission systems by levels based on the five levels of national dispatching, large region dispatching, province-level dispatching, prefectural dispatching, and county-level dispatching. We will try to make China's power grid dispatching automation and communications technology attain advanced world levels.

This article is a comprehensive report given by council director Zhang Fengxiang at the "China Generator Engineering Symposium Electric Power System Young S&T Workers Scholary Report Meeting" at Chengdu in 1992. It has been abridged here for publication space reasons.

Strategy of Developing the Rural Energy Structure

936B0063B Beijing ZHONGGUO NENGYUAN [ENERGY OF CHINA] in Chinese No 2, 25 Feb 93 pp 26-28

[Article by Li Ji [2621 7139] of the State Planning Commission and Chinese Academy of Sciences Energy Resource Institute: "Ideas on China's Rural Energy Resource Structure Development Strategies"]

[Text] The strategic objective for China's economic development is: by the end of this century, to achieve a relatively prosperous level, and by the mid-21st Century, to basically achieve modernization, attain the level of the moderately developed nations in per capita GNP, and enable our people to have relatively prosperous lives.

Based on this strategic objective, enormous changes will occur in China's future population structure and industrial structure. According to projections by the relevant experts, the proportion of China's rural population will evolve from the present 75 percent to about 30 percent in 2050 and agriculture as a proportion of China's industrial structure will evolve from the present one-third to about one-twelfth in 2050. These figures were projected by the experts on the basis of historical experience in foreign countries and China's present situation, but the shift of the

rural labor force toward cities is an inevitable stage in the socioeconomic development of all the world's countries, and China similarly cannot evade or jump over this historical stage. The shift of China's agriculture toward industry and services and the shift of our rural population toward the cities is an inevitable change trend.

China's biggest problems in social development for a relatively long period into the future will come from rural areas. If the 800 million-plus peasants who comprise 75 percent of China's population do not become prosperous as quickly as possible, it will be hard to achieve China's strategic objective. A small portion of the shifted rural population in China will depend on absorption by existing cities, but most of them must depend on themselves. Development of rural industry will make rural industry move onto the track of intensification and gradually draw close to cities and continually develop to form an urban scale and achieve urbanization. Thus, urbanization and industrialization in China are to a substantial degree manifested as rural industrialization and rural urbanization.

Rural energy resources are an important material foundation for China's achievement of agricultural modernization. They are related to improvement of peasants' lives and the ecological environment as well as to the development of rural production and the rural economy and to progress in rural industrialization and urbanization. The rural energy resource question should attract the attention of all of society.

We will do a simplified analysis of the associated changes in the rural economic structure as China achieves basic modernization in the mid-21st Century and the corresponding evolution in the rural energy resource structure.

1. From the perspective of the shift of the rural population

At the mid-point of the 21st Century, China will have a population of about 1.5 billion, about 30 percent or 450 million of which will be a rural population. This also means that about 600 million of our rural population will move to cities. The main energy resources currently used in the lives of these peasants are straw, firewood, and other biomass energy resources that account for 80 percent of total rural household energy resource consumption. By 2050, all the household energy resources used by these 600 million peasants who may move to the cities will be commodity energy resources, and the main varieties of household energy resources are coal, electricity, coal gas, finished oil, heat, and so on, so demand for secondary energy resources will grow. Thus, the shift of the rural population will greatly increase the amount of commodity energy resources consumed in urban households. We must solve the problem of increased consumption of household commodity energy resources by the rural population that moves to the cities before we can shift our rural population and urbanize rural areas.

2. From the perspective of changes in the agricultural industry

To achieve our strategic objectives for economic development, China will have to completely change its backward situation as an agricultural nation and make the sum of secondary and tertiary industry surpass 92 percent of our GNP, so agriculture will only account for 8 percent of our GNP. Whether or not rural industrialization can develop smoothly also restricts the achievement of this structural readjustment.

Rural industrialization requires the continual development of township and town industry. We have readjusted the industrial structure of township and town enterprises and exploited energy conservation potential in the enterprises, but this will inevitably result in a substantial increase in demand for commodity energy resources in rural areas. Moreover, stable development of township and town enterprises requires stable, reliable, and safe energy resource supplies.

Thus, guaranteeing supplies of commodity energy resources in rural areas concerns the development problems of rural industrialization and it concerns whether or not rational readjustment of China's industrial structure can proceed smoothly so that China takes the road of prosperity. The trend of increased demand for commodity energy resources is an inevitable transformation that is beyond the will of people.

3. From the perspective of agricultural production in rural areas

For China to basically achieve modernization, the added value from agriculture will be 4 times the present amount. Because of birth control and the movement of the rural population toward cities, our rural population will be reduced to just 450 million. The future development of agriculture must inevitably abandon manual labor methods that depend on manpower and animal power and increase the degree to which it relies on mechanization. Thus, it is normal for the development of the agricultural sector to have a higher energy resource consumption elasticity coefficient. According to expert estimates, it may be maintained at about 1, so the amount of demand for commodity energy resources in the agricultural sector will be about 4 times that at present. From another perspective, to meet demand for commodity energy resources in the agricultural sector, the degree of mechanization must be increased before substantial agricultural labor power can be liberated so that this labor power can be effectively input into the industrial production realm and thereby accelerate the achievement of China's magnificent goals for reform and opening up and development of the socialist commodity economy.

4. From the perspective of improving the quality of peasant life

After rural areas move toward a more prosperous life, there will be more ways that peasants use energy resources. Energy resources will not just be serve as fuel to supply the peasants for cooking. They will also be used to meet the material and cultural living requirements of the peasants.

Besides increasing the amount of energy resources consumed for winter heating and summer ventilation for cooling, household appliances will become increasingly common, there will be a greater variety of products, and the grades will be ever-higher. As for the energy resources that serve as fuel, peasant demands for quality will be higher in the future and it will be hard to use the past method of directly using straw and firewood for fuel. It is hard to imagine that after they become prosperous the peasants will still be willing to burn straw for fuel. People will be willing to spend more money to buy clean and convenient energy resources. One, they can conserve time and reduce labor, and two, they do not pollute the environment and do not affect their physical health and residential sanitation.

Because of S&T developments and technical progress, new energy resources will be used more widely and the technology for utilization of biomass energy resources will be continually improved.

Thus, a very large part of the household energy used by peasants will be converted into traditional commodity energy resources and renewable energy resources, and there will be significant changes in the rural household energy consumption structure.

In summary, to achieve China's strategic goals for economic construction, we must increase supplies of rural commodity energy resources, new energy resources, and so on, and replace as quickly as possible backward, low-quality non-commodity energy resources with commodity energy resources and new energy resources to adapt them to the development of rural industrialization and urbanization and to development of the rural economy. This is a practical problem that we face.

Nevertheless, for a long time China's vast rural areas have always been in a closed or semi-closed natural economic state and the greatest part of rural energy resource consumption was is self-sufficient and primarily biomass energy resources. With reform and opening up and the development of the rural commodity economy, demand for commodity energy resources in rural areas will continue to grow. However, because of the surging growth in demand for energy resources in the process of reforming China's economy, we have extremely serious energy shortages. The focus considered in state plans is on industry and urban areas, and there have not been significant changes in the structure of rural energy use. Despite this, household consumption of biomass energy resources in China's rural areas as a proportion of total household energy resource consumption in rural areas dropped from 85 percent to 80 percent from 1979 to 1989, an average annual reduction of 0.5 percentage points. With future development and perfection of the market economy and the expansion and comprehensive opening up of the energy resource market, the speed of structural changes may increase significantly.

However, the development situation for China's energy resources is certainly not optimistic, and there must be correct guidance and intelligent policies concerning the substantial growth in demand for commodity energy resources in rural areas. I feel that preferential consideration should be given to the following points.

1. Open up the energy resource market as quickly as possible

The industrialization and urbanization of China's rural areas will have their own characteristics. It will be difficult for cities to absorb such a huge agricultural staff and the development of rural industrialization can only be accelerated on the basis of expanding township and town enterprises in rural areas, so many townships and towns will gradually expand and become cities. Thus, energy consumption in township and town enterprises should be treated the same as energy use in state industry and certainly cannot be ignored.

Since 1979, reform of the economic system has gradually increased the market as a component of China's economy, but the energy resource market is still imperfect. With the continual development of China's commodity economy, township and town industry will continue to develop and grow, as will demand for commodity energy resources, and the contradiction between supply and demand will become more intense. Moreover, this problem will be more acute in the more industrially developed regions. For example, Ningbo City, one of China's 10 star cities with a gross value of industrial and agricultural output in excess of 20 billion yuan, has a 43 percent shortage of rural commodity energy resource supplies. This has forced township and town enterprises and peasant households in this economically developed region to search for energy resources in the cracks, which has impacted the state's energy resource supply plans. If we open up the market and gradually deregulate prices, energy resources will move into the market as commodities and those who need them can select them freely. In a situation of growing shortages of commodity energy resources, importing market competition mechanisms into the energy resource supply system will inevitably improve the utilization results of energy resources, make energy resources adapt to the growing socialization of economic activity, and benefit development of the energy resource industry, which will fundamentally transform the current passive situation in the energy resource industry of almost comprehensive losses and total reliance on state investments.

2. Adapt to local conditions in developing rural energy resources

China has vast rural areas and there are substantial differences in living standards among different regions, and energy resource consumption levels are also in different stages. We should adapt to local conditions in carrying out rural energy resource construction based on the energy resource and consumption situations in rural areas and strengthen the utilization of energy resources that are produced in rural areas themselves in order to alleviate their energy resource shortages and guarantee the sustained development of our rural economy.

In the economically more developed coastal areas of southeast China, for example, work on large-scale extension of wood and coal-saving stoves is nearing an end and

small household methane pits are also getting the cold shoulder. Township and town enterprises have also developed rather quickly in these regions, so the rural energy resource strategy in this areas should be to focus first on rural energy conservation work that places energy conservation in township and town enterprises in a prominent position, followed by doing good commodity energy resource supply work along with active research and extension of new energy utilization technologies and development and utilization of local energy resources to make them an important supplement to the energy used in rural production and life. Moreover, we should also encourage the peasants and enterprises to investment in the energy resource industry and accelerate the development of the energy resource industry.

In more economically backward regions, the shortage of rural fuels is still very acute. This has resulted in land desertification, soil erosion, and a loss of ecological balance, which has also obstructed the development of agricultural production and formed vicious cycles. In these regions, it is necessary to develop firewood-saving stoves and an energy consumption system in which methane pits and small-scale hydropower supplement each other. However, it is also very important that they focus on utilization of new energy resources and develop township and town coal mines, wind power, solar power, and so on in places that have the proper conditions.

3. Accelerate progress in electrification

Electricity is the cleanest energy resource and a prerequisite for technical progress. Using electric power to replace other energy resources has significant energy conservation and economic benefits. The degree of electrification is one standard used to evaluate modernization and an energy resource development strategy centered on electric power is a world trend.

The extent of electrification is low at present in China's rural areas. Per capita household electricity use in China's rural areas in 1990 was 25 kWh [as published], just one-fourth the level of urban residents. China's rural enterprises consume 1,076 kWh of electricity per 10,000 yuan in value of output whereas electricity consumption per 10,000 in gross value of industrial output in China as a whole is 3,104 kWh. The amount of electricity consumed per 10,000 yuan in value of output of rural enterprises does not mean that their economic results are good. Instead, it is a much greater reflection of the low levels of electrification and high manual labor component in rural enterprises.

To spur development of our rural economy, improve the people's living conditions, conserve labor power, and improve working conditions, we should accelerate the pace of electrification. In addition, intensification of rural industry will aid the development of rural electrification. To spur rural industrialization and urbanization, electric power is the foremost superior quality energy resource that other energy resources cannot compare with. Increasing the degree of electrification will reduce the many shortcomings that arise from direct utilization of primary energy resources and aid in the development of rural urbanization.

Furthermore, as our economy continues to develop, society will develop from a material intensive-type to an information-intensive type and electric power will play a vanguard role.

It would be best if the development of rural electric power does not stop at the level of small power plants and small power grids and reliance on self-sufficiency. Instead, it should move as quickly as possible toward local networks and high-efficiency electromechanical equipment. Simply relying on the development of small-scale thermal power will not solve our future rural development requirements.

The development of the rural electric power industry also requires the implementation of raising capital through multiple channels and developing power in a variety of ways to promote increased power output and power grid development. We must formulate policies to encourage rural areas to invest in state power grids and expand the scale of electricity supplies to rural areas by state power grids if we wish to accelerate the pace of rural electrification.

4. Actively develop clean renewable energy resources

Most renewable energy resources are clean energy resources. Their development and utilization can improve the environment and substantially raise rural energy resource self-sufficiency rates. During a period when rural areas move toward industrialization and urbanization, demand for commodity energy resources will continue growing and the contradiction between supply and demand will become increasingly acute, so large-scale development and utilization of renewable energy resources is an important way to alleviate the contradiction between energy resource supply and demand. Using clean energy resources will spur the course of evolution of rural areas toward urbanization.

China has vast rural areas with a rather large variety of resources that are broadly distributed. Besides major efforts to improve utilization modes for biomass energy, we should actively develop solar power, wind power, geothermal energy, and other resources. The degree of their development and utilization is very low at present, so they have great potential.

In summary, the rural energy resource structure starting now should evolve in a direction that spurs the modernization of rural areas.

To Develop, Power Industry Must Break with Convention

936B0070B Beijing JINGJI BAO in Chinese 1 Apr 93 p 7

[Article by reporter Xie Ranhao [6200 3544 3185]]

[Text] "A more daring effort and strong reform measures are needed to make the electric power industry break with convention in its development." This bold statement was made to a gathering of reporters by the head of the newly formed Ministry of Electric Power Industry, Shi Dazhen.

Facing a rapidly growing economy throughout the country, Shi Dazhena an expert in the electric power industry for over 30 years, talked about the challenge of the newly

created Ministry of Electric Power Industry, and his sense of bearing this heavy responsibility. He said that China's economic development plan, following readjustment, calls for an estimated 920 billion kWh of electric power to meet China's needs in 1995, and between 1.34 and 1.47 trillion kWh in 2000. If the new increase in large- to middle-sized generators in the Eighth 5-Year Plan is 64,000MW, and adding on the volume of middle- to small-sized units, the 1995 national output could reach 920 billion kWh. If the average annual increase of large- to middle-sized units during the Ninth 5-Year Plan is 20,000MW, by 2000 the national output will then reach 1.4 trillion kWh, doubling that for 1992. But, that is the very minimum required. If not reached, then this "first imperial residence" of the electric power industry could well be tugging at the hind quarters of China's economic development. Shi Dazhen was, therefore, emphatic that if the electric power industry doesn't break with convention, there will be no way to avoid the present situation of starts and stops, which make it difficult to assure power for consumption and is an detrimental to normal livelihood.

The difficulty of realizing the above goals will be extreme. Supplying facilities and balancing the required external conditions will be tough enough, but raising the billions needed for investments in electric power each year will be even more difficult.

How will the electric power industry overcome such difficulties?

"By facing the problem head on, being more daring, and moving a little faster." Shi Dazhen said, since reforms began with Premier Li Peng leading the electric power industry, the tethers of the old idea of relying solely on the state to get electricity were loosened, and money for electricity was raised within the country and foreign funds were brought in as well, which led to eye-opening results, as the production of electricity and the installed capacity, which was fourth in the world in 1987, grew rapidly; and especially in the last five years, the installed capacity increased at an annual average of over 10,000MW, and the new installed capacity increased 60,000MW in 5 years, roughly equivalent to the total for the 30 years prior to the opening of reforms, which not only was unprecedented in China, but led the whole world in the same time frame.

In view of that, said Shi Dazhen, even more daring reforms; whatever can be done positively should be done; whatever policy applies, apply it; whatever funds can be used should be used to accelerate development of the electric power industry. The approach to take is to encourage investments in share holding stocks wherever conditions are favorable within the country, and guaranteeing that local and foreign investors get a fair return for their investments, moving faster on reasonable prices for electricity, making prices able to return capital with interest in reasonable profits; and consideration should be given to increasing electric power construction funds, such as by adding a few coins per kWh of electricity for construction.

The main task at hand for the newly formed Ministry of Electric Power Industry, said Shi Dazhen, is to get electric power enterprises into the market as soon as possible, especially electric power design, engineering, scientific research, and reconstruction; and the variously managed enterprises must work harder to be competitive in the market.

To get enterprises active more quickly, Shi Dazhen considers that Ministry organizations must make functional changes, have better troops and simpler administration, reasonable interrelationships, and be more efficient. In principle, Ministry organizations are not in control of enterprise people, finances or goods. These are things better handled by the enterprises themselves, and wherever Ministry authority is of limited reach, the authority should be passed down completely, and legal independent enterprise management should be supported; where Ministry authority is limited, the Ministry will strive to assist enterprises and give support to enterprises in taking the authority given to them. In a word, stipulate by "regulation," and return all rightful independent authority to the enterprises; create a good external environment for the conversion of the enterprise management system.

Of course, the enterprises must be lively, and when they gain competitive strength after entering the market, they can't forget about furthering reform of their internal mechanism. For this, Shi Dazhen considers the present enterprise reform still to be a 3-point system reform, earnestly convert the management system, the reform of the enterprises developing and supplying power should include setting up mechanisms for incentives, and they must become genuine first class independent accounting entities under the unified leadership of the network. Each electric power enterprise group and provincial corporation must also be reformed and become genuine "Four-independents" economic entities.

Shi Dazhen said, in closing, that the speed at which the economy is developing is a challenge for the electric power industry, and it is also an opportunity; and the trick is to make the best of that opportunity and spur the electric power industry on to a more rapid development.

Shanghai Sets Manufacture of 600MW Generators as Main Objective

936B0069B Shanghai JIEFANG RIBAO in Chinese 10 Mar 93 p 1

[Article by reporter Zhang Zhiyuan [1728 5268 6678]: "Shanghai Decides on Objective for Primary Attack: Manufacturing 600MW Generators"]

[Text] Shanghai has decided to make the manufacture of 600MW generators the objective of its primary attack, in particular the need to leap up to a new stage in supercritical technology, and to make development of this large generator the dragon's head of its contractual responsibility capabilities to spur the entire power plant production industry and make it a pillar industry in Shanghai.

On 9 March 1993, Ministry of Energy Resources minister Huang Yicheng [7806 3015 6134] pointed out while

inspecting Shidongkou No 2 Power Plant that China has now decided to make 600MW generators its primary generators and that every effort should be made to deploy newly-built power plants in coastal regions with these large, advanced, and highly efficient generators and to use them to transform the backward equipment, high coal consumption, low efficiency, and long technical renewal schedule situation in China's electric power industry.

Shanghai now has the conditions for assuming contractual responsibility for 600MW supercritical generators. During the Eighth 5-Year Plan, Shanghai has made a preliminary decision to invest 600 million yuan in technical upgrading capital in its power plant production industry, and it has approved more than 270 million yuan in additional funds for trial manufacture of 600MW nuclear power generators.

State Council Major Projects Office director Li Shouren [2621 1343 0088], Ministry of Energy Resources minister Huang Yicheng, Shanghai Municipality vice mayor Jiang Yiren [5592 0110 1103], and Ministry of Machine-Building and Electronics Industry chief engineer Yao Fusheng [1202 4395 3932] attended the technical symposium on thermal power generation supercritical technology held at Minhang in Shanghai on 9 March 1993.

Zhejiang To build 2400MW Plant on Coast

936B0072B Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 19 Apr 93 p 1

[Article by reporters Zhao Xiangru [6392 4161 1172] and Yuan Yaping [5913 0068 1627]]

[Excerpt] Hangzhou, 17 Apr—The China Huaneng Enterprise Group and the Zhejiang Provincial People's Government have together invested 10.3 billion yuan to build a large thermal power plant on the coast of Zhejiang with a total installed capacity of 2400MW. This will be a major action in Zhejiang's economic construction.

A document of intent to build, by joint venture, a power plant on the coast was signed on 16 April by Zhejiang and Huaneng. An investment of 5.5 billion yuan will be made for the first-stage construction to be done at the end of the Eighth 5-Year Plan and during the Ninth 5-Year Plan.

Cooperation between the China Huaneng Enterprise Group and Zhejiang Province began in the 1980s. The Huaneng Group, which invested 900 million yuan in the Qinshan nuclear power plant, is involved in making conversions from coal to oil, and has made direct investments for electricity in four power plants and power stations. [passage omitted]

Shanxi Energy Base Update

936B0077B Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 11 May 93 p 2

[Article by reporter Wu Feng [2976 1526] and intern Liu Haoyuan [0491 3185 6649]]

[Text] Taiyuan, 11 May (XINHUA)—Shanxi is taking advantage of its unique coal resources to build a southeast Shanxi electric power base. Construction of two Yangcheng large-scale power plants is programmed for the early-stage construction of the southeast Shanxi electric power base, each with an installed capacity of 4,000MW, and they will transport electric power, separately, to Jiangsu and Guangdong. The Zhongze power plant with 1,000MW installed power has been built and will provide electric power mainly for Shandong Province. Once this base is built it will raise the economic efficiency of Shanxi coal, and will relieve the pressure on railroad transportation.

The southeast Shanxi electric power base will be undertaken by the Shanxi Energy Industry Enterprise Group, and beginning this year it will host over 20 financial groups from seven countries and territories including, the U.S., Canada, Hong kong, Singapore, Germany, Taiwan, and Japan to discuss investing in electric power.

After multilateral talks, the U.S. AES Corporation and Germany's Keluokena [0344 3157 0344 4780] Corporation initialed a joint venture with China for the second-stage of construction of the Yangcheng No 1 power plant for a total investment of 10 billion yuan; and the Hong Kong Zhongce Corporation, National Energy Investment Corporation, Jiangsu and Jiangxi signed a four-party joint venture agreement for the first-phase construction of the Yangcheng No 1 power plant for a total investment of 8 billion yuan.

Shanxi: 400MW in New Power Construction

936b0070A Taiyuan SHANXI RIBAO in Chinese 25 Mar 93 p 1

[Article by Shang Pusheng [1424 2528 3932], Yang Shuxiang [2799 5486 0686], and Lei Jiande [7191 1696 1795]]

[Excerpt] [passage omitted] This is the first year of the campaign for Shanxi to convert from transporting coal to transmitting electricity, and to put coal and electricity on equal footing.

The Spring Festival has just passed, and the various units and leaders of the Provincial Electric Power Bureau, who are shouldering the heavy responsibility, sprang immediately back into action. The Yangcheng No 1 power plant with 2,100MW of installed capacity will be the juggernaut for exporting electric power from Shanxi. Provincial leaders made many personal liaisons to get the project tabled by the pertinent national departments. While the Provincial Electric Power Bureau was dispatching specialists to Beijing to lobby for the project, it was already sending engineering units of the Provincial Power Construction No 3 Corporation to the work site ahead of schedule to make early preparations. The Provincial Government now is also getting construction underway at the Yangchuan No 2 power plant with 1,200MW installed capacity, the Taiyuan No 1 power plant with 600MW installed capacity, and the Liulin power plant with 200MW installed capacity. On the construction scene, construction workers are well into the early stage effort on "5 fronts," to assure that formal construction begins this year. At the ssame time, the Provincial Electric Power Bureau is immersed in projects on which construction has already begun. When the Provincial Power Construction

No 4 Corporation got the No 2 300MW unit at the Taiyuan No 1 power plant running, and after taking only 10 days for the Spring Festival, they moved their main engineering force to the Yushe power plant. On 22 February, the Provincial Electric Power Bureau chief leaders braved the bitter cold to hold a mobilization meeting at the construction site. Now, the engineering units, having worked day and night, have finished the pile-driving work for the Yushe power plant ahead of schedule. Also, Shanxi has asked that work be stepped up to get one 200kW unit at the Taiyuan No 2 power plant and two 50kW units at the Datong No 1 power plant into operation this year. In order to guarantee that Shanxi will export more electricity this year, the Provincial Electric Power Bureau, while well into construction, is also taking measures to assure steady output from the newly operating units.

Today, the Provincial Electric Power Bureau dispatched two technical guidance teams to get involved in operations at the Shentou No 2 power plant and the Taiyuan No 1 power plant's two 300kW units to assure that the new operation units are running well and producing more electricity.

Ningxia Electric Power Construction Update

936B0062B Yinchuan NINGXIA RIBAO in Chinese 26 Feb 93 p 3

[Article by Yu Hai [0060 3189]: "Successive Major Plays on Stage in Electric Power Construction in Ningxia Hui Autonomous Region"]

[Text] Ningxia Hui Autonomous Region's electric power industry leapt up to a new stage during 1992 and is welcoming a new high tide of electric power construction during 1993. I learned from the Ningxia Hui Autonomous Region Electric Power Industry Conference held on 25 February 1993 that Ningxia plans to invest 319 million yuan in capital construction in the electric power industry during 1993, an increase of 31 percent over 1992 and the largest yearly amount invested in history. This will create effective conditions for turning Ningxia Hui Autonomous Region into an electric power base area having an initial scale in China.

Electric power construction in Ningxia during 1993 will be focused primarily on the following projects:

1. The Bao-Zhong [Baoji-Zhongwei] railroad electricity supply project. Because the Bao-Zhong railroad will be opened to traffic 1 year ahead of schedule, the electricity supply project must also be moved ahead by a corresponding amount to ensure that it is completed and supplied with power prior to 1 May 1994. For this reason, we must guarantee that the cross-river section of the Xinling 220 kV line and the remaining projects at the Lingwu power transformation site as well as the cross-river section of the Guying 220 kV line and the installation project for the Yingshuiqiao power transformation site are completed and placed into operation according to plan. In addition, we must open up one line on the Bao-Zhong 110 kV electric railroad power supply project and the civil engineering and equipment must be put into place for the two power transformation sites at Wating and Sanying.

2. The Dagu 330 kV power transmission and transformation project. The line in this project is the second trunkline to link the Ningxia Hui Autonomous Region power grid into a large grid and it will be built in phases. The construction staff must make progress every day and try to basically put the entire line into place during 1993. The Guyuan power transformation site for this project is the first 330 kV power transformation site in Ningxia Hui Autonomous Region and it is the key station for connecting into the large grid as well as an important part of the Bao-Zhong electric railroad power supply project.

3. Daba Power Plant second phase project. After the state formally approved construction of this project, the Ningxia Hui Autonomous Region Electric Power Bureau organized forces to carry out to undertake preparatory work involving putting in roads, power, and water and grading the site to start construction, and the progress situation is such that the conditions are basically in place for a formal start of construction in July 1993.

In addition, the Pingxi power transformation site, Yuqiao power transformation site, southern suburbs transformation site, Tangqu power plant, and other projects have all been included as projects for construction during 1993.

Besides the projects above, preparatory work will also get underway during 1993 for several projects arranged for the Eighth 5-Year Plan. They include the second phase 220 kV outward power transmission project at Daba Power Plant, the 2 X 300MW expansion project for the sixth phase at Shizuishan Power Plant, the Baotou-Lanzhou railroad electrification project, and the Qingtongxia 330 kV power transformation site project.

Shuozhou Energy Base Taking Shape

936B0069A Beijing RENMIN RIBAO in Chinese 29 Mar 93 p 4

[Article by reporter Zhang Zhiren [1728 1807 0088]: "Shuozhou Energy Resource Base Area Has Initial Scale, State To Invest 10 Billion Yuan in Construction of Shuozhou Key Project"]

[Text] A modern new energy resource city is now rising at Shuozhou in Shanxi. The state will begin investing 10 billion yuan here in 1993 for construction of a key project.

Shuozhou City has been under construction for 4 years and its energy resource base area has now attained an initial scale. The value of output from coal-fired power accounts for 84.7 percent of the city's gross value of industrial output. This area is extremely rich in mineral resources and has already been proven to have 17 types including coal, limestone, bauxite, mica, graphite, and others, and this includes 14.55 billion tons of coal reserves. Now, besides the huge enterprise being built by the state, Pingshuo open-cut coal mine, the number of local mines and jointly-run mines in Shuozhou City has reach 251 and their output has surpassed 10 million tons.

Shuozhou City is also the largest electric power city in the north China region. The installed generating capacity at Shentou No 1 Power Plant and No 2 Power Plant has reached 2,350MW and they are generating 12 billion kWh of electricity annually.

As an important step in Shanxi Province's strategy for "converting coal into electricity", the state has decided to build two additional large 600MW thermal power pit-mouth generators at Shentou.

To resolve Shuozhou's severe water shortage, the State Council has approved the start of construction on a project at Wanjiazhai to divert water from the Huang He into Shanxi. This water diversion project will cost 5.37 billion yuan, of which the state will invest 2 billion yuan.

Nation's First Nickel-Hydrogen Battery Production Line Operational

93P60247A Shanghai WEN HUI BAO in Chinese 6 May 93 p 2

[Article by Xu Qianwei [6079 0467 0251]: "Key Problem of Nickel-Hydrogen Battery Successfully Tackled in Tianjin"]

[Summary] Tianjin (WEN HUI BAO special dispatch)—Chinese scientists and engineers have successfully tackled one of the "hottest" technical problems in research on new energy sources: the development of a nickel-hydrogen battery. Moreover, in only 4 months' time, the Tianjin Municipal Science and Technology Pioneer Service Center (TMSTPSS) has taken this scientific research achievement into trial production, with the completion of construction on the nation's first nickel-hydrogen battery production line. A few days ago experts certified both the assembly line (with an annual single-shift production capacity of 500,000 batteries) and its products to be at the worldwide state-of-the-art. China thus joins a small number of nations able to commercialize this new high-tech product. TMSTPSS at the beginning of the year took this new battery, developed in the laboratory by Nankai University and MMEI's Tianjin Power Supply Research Institute (PSRI), established the high-tech industrial entity Jinguang [6855 0342] Corp., and arranged for PSRI to design and manufacture the trial production line, which was completed and put into operation at the end of March this year. The State S&T Commission has decided to build a "State New Energy-Storage Materials Research Center" at this site.

Planning Future Grids To Assure Power Supply

936B0067B Shanghai JIEFANG RIBAO in Chinese 19 Mar 93 p 3

[Article by reporter Guo Changxi [6753 2490 3588]: "Plan Future Power Grids, Provide Energy Resource Guarantees—East China Electric Power Design Academy Is a Good Vanguard Commander for Pudong Development"]

[Text] The East China Electric Power Design Academy, which has distinguished itself in battle in energy resource construction in China, now has a new attitude in actively planning the network for a power grid for future electricity use in the Pudong New Zone and has decided to be a good vanguard commander for large-scale development of Pudong. This information was revealed to reporters by academy director He Yehong [0149 2814 1347] in commemoration of the academy entering the age of certainty.

The Electric Power Design Academy has surveyed and designed over 100 power plants having 362 generators with a total installed generating capacity of 22,630MW for the state over the past 40 years. Since 1985, the capacity placed into operation for which the surveying and design was the responsibility of the academy has accounted for nearly one-fourth of the total thermal power capacity placed into operation in China, and it has completed nearly 10,000 kilometers of auxiliary power line project surveying and design, including over 1,200 kilometers of 500 kV circuits. It has designed over 120 power transformation stations with a total capacity of 15,125 MVA. It has now assumed responsibility for designing the construction blueprints for eight 300MW generators at the Waigaoqiao, Jiaxing, and Ma'anshan power plants and for designing the conventional island for a 300MW nuclear power plant in Pakistan, a thermal power plant in the Philippines, and a power transmission line project in Indonesia.

The plan for the power grid for Pudong New Zone is an important part of the power grid plan for the Shanghai region. By using their demonstrations in Pudong New Zone as a focus for China's opening up to the outside world, its increase in power use levels will be higher than the average levels in Shanghai. According to projections, its maximum load in the year 2000 will reach 1,200MW and its maximum load in the year 2020 will approach 5,000MW and it will require 21 billion kWh of electricity annually, equal to present electricity use levels in Shanghai. Construction is now in progress at Waigaoqiao Power Plant in Pudong New Zone. The first phase project will have an installed generating capacity of 1,200MW and be completed in its entirety in 1996. They will also be involved in completion of a 500 kV power supply loop for the Shanghai region that will include the Pudong New Zone.

To promote a new takeoff in the economy of the Chang Jiang Delta and the entire Chang Jiang Basin, they are now doing preparatory work on power source deployment sites in over 10 regions along the coast and the river. To date, the reserve capacity at the power plant sites has reached 25,000MW.

Power Demand Forces Upgrading of East China Grid

40100091E Beijing CHINA DAILY (Business Weekly) in English 14 Jun 93 p 4

[Text] Rapid economic development in East China is putting an extra strain on the power network in that part of the country.

The network mainly supplies electricity to Zhejiang, Jiangsu and Anhui provinces and Shanghai. In recent days, electricity consumption in the provinces and the city has exceeded the planned amount.

Power demand soars with the temperature in East China as people switch on their air conditioners.

The East China network mainly uses thermal power plants, but coal is in short supply because of transportation problems. Some areas in East China have already suffered from blackouts.

It is estimated the peak load of the network will reach 20.2 million kilowatts this summer, an 11.5 percent increase over the same period last year, according to the CHINA BUSINESS TIMES.

The East China Power Industry Group is co-operating with related departments to solve the coal shortage problem and strengthen management of power distribution to guarantee the power supply during the hot weather. The East China power network has developed at an unprecedented speed in the last decade. The network is expected to have a total installed capacity of 55 million kilowatts by the end of the century.

By that time, the network will mainly use thermal power plants equipped with 600,000-kilowatt and 2.4-million-kilowatt generation units, nuclear power stations and hydropower plants. Electricity supplied by other parts of the country is also expected to be transmitted into East China to meet its increasing demand.

According to WEN HUI BAO newspaper, seven thermal power plants have been built since 1980 in East China. During the period, the country's first self-designed, constructed and tested nuclear power project, Qinshan Nuclear Power Station, has been completed. By the end of 1992, the network's total installed capacity reached 30.7 million kilowatts, making it the largest power network in China.

With such a big installed capacity, the network still failed to provide enough electricity to the area in 1992.

In order to expand the construction of power facilities, the newly-established East China Power Industrial Group has recently revised its five-year plan (1991-95) for power development in East China. According to the new plan, generation units with a combined installed capacity of 11 million kilowatts will be added to the network between 1991 and 1995, 1 million kilowatts more than the original plan. The installed capacity is expected to increase another 21 million kilowatts between 1995 and 2000.

To reach the target, the group has selected several locations along the East China Sea coast and the middle and lower reaches of the Yangtze River for the construction of large-scale power plants.

At present, the group is busy with the construction of six power plants in Yangzhou, Shidongkou, Beilun Port, Jiaxing, Waigaoqiao and Nanjing. The second-phase project of the Qinshan Nuclear Power Station is also under construction.

The group is also making preparations for the construction of facilities for receiving electricity supplied from other power grids in China. (BW News)

Guizhou Preparing To Put Batch of Power Facilities Into Operation

936B0065 Guiyang GUIZHOU RIBAO in Chinese 1 Mar 93 p 1

[Article by GUIZHOU RIBAO reporter Li Weihong [2621 5898 4767]: "Electric Power Construction Focuses on Accelerating Pace, Several Key Hydropower and Thermal Power Projects in Guizhou Province Go Into Operation, Construction Begins on Several New Projects, Transmission of Power to Guangdong Planned for June"]

[Text] Electric power construction in Guizhou Province is resolutely combining hydropower and thermal power, focusing on the quality and progress in each key hydropower and thermal power construction project, and gradually accelerating the pace of electric power construction.

Planned capital construction investments in Guizhou Province's electric power system during 1992 were 896 million yuan, which included 811 million yuan in capital construction investments in large and medium-sized electric power projects, an increase of 56.44 percent over 1991. Good achievements were made in completing and placing into operation on time or ahead of schedule every project that was to become operational in electric power capital construction. During 1992, we added 1,315MW in new installed generating capacity, 500 MVA in power transformation capacity and 265 kilometers of power transmission lines at 500 kV, 336 MVA in power transformation capacity and 123 kilometers of power transmission lines at 220 kV, and 73 MVA in power transformation capacity and 160 kilometers of power transmission lines at 110 kV. The Panxian Power Plant project completed its yearly investment plan and the two big goals of water diversion for the main plant building and the large crane for the boilers were completed by year's end. In a situation of guaranteeing that the capital was in place, the Dongfeng Hydropower Station project safely passed floodwaters and it appears that progress basically has met requirements. The 500 kV power transmission project from Tianshengqiao to Guiyang was completed in its entirety and placed into operation. On 3 December 1992, Guizhou and Guangdong Provinces signed an agreement that beginning in 1993 Guizhou would transmit seasonal power to Guangdong from June to October until the year 2012.

Guizhou Province's electric power system will make shortening construction schedules its breakthrough point during 1993, focus all its efforts on capital construction, and comprehensively accelerate the pace of electric power construction in Guizhou Province. The first 200MW generator at Panxian Power Plant will begin generating electricity in September. Two generators at Puding Hydropower Station will go on line in June and November, respectively. An effort will be made to have the first 170MW generator at Dongfeng Hydropower Station generate power by the end of 1993. Sales will be wrapped up within the year for the expansion project at Zunyi Power Plant. Construction will also begin on the Tianshengqiao first cascade power station and the technical upgrading project at Guiyang Power Plant. Anshun Power Plant and Hongjiadu and Longtang Hydropower Stations will enter the construction preparations stage. Added to the related 220 kV and 110 kV power transmission and transformation projects, it has been projected that an investment of 1.2 billion yuan will be required for electric power construction in Guizhou as a whole during 1993, an increase of about 30 percent over 1992, and Guizhou Province will have to raise nearly 500 million yuan of this investment.

Proposal Made To Step Up Production of Supercritical Units

936B0067A Shanghai JIEFANG RIBAO in Chinese 12 Mar 93 p 2

[Article: "Promote Shanghai's Power Plant Industry as a Pillar Industry, Gu Xunfang [7357 6064 2455] Proposes Accelerating Development of Supercritical Generators"]

[Text] Gu Xunfang, advisor to the Shanghai Municipality Integration of Science and Technology with Production Key Industrial Project Battle Leadership Group, recently proposed that Shanghai accelerate development of supercritical generating units to make Shanghai's power plant industry truly become a pillar industry. His proposal attracted the attention of leading comrades in Shanghai Municipality. They feel that it is extremely significant for readjustment of Shanghai's industrial structure and spurring economic development.

Gu Xunfang pointed out that many of China's cities still have serious power shortages. Average annual per capita electricity use in China is 623 kWh, just one-twelfth that in the advanced countries. Thus, accelerating development of the electric power industry cannot be delayed. China presently has 165,000MW in power generation equipment installed generating capacity and generates a total of 742 billion kWh of electricity a year. Although this is fourth place in the world, we have backward equipment, high coal consumption, low efficiency, and long technical upgrading schedules, and we lag quite far behind advanced world levels:

1. Medium-sized and small generators account for a large proportion. Some 40 percent of our total thermal power installed generating capacity is comprised of 50MW units and 36.8 percent is comprised of 125 to 250MW units. As for 600MW (supercritical) units, at the end of 1992 we had only two generators at the Shidongkou No 2 Plant that had just been connected to the grid and were generating power.

2. High coal consumption, low power supply efficiency. In 1992, average coal consumption was 415 grams/kWh in China and 330 grams/kWh in the more advanced nations, so we lag 85 grams/kWh behind them. Calculated at a thermal power output of 556.5 billion kWh in 1992, we had to consume an additional 47 million-plus tons of coal. To transport this much coal from coal mines in Shanxi and other parts of the central China region required a transportation capacity of 940,000 tons of railroad cars or 4,700 steamers of the 10,000-ton grade, which added to the pressures on China's extremely short communication and transportation and involved enormous waste.

3. Technical upgrading schedules are long. All of the developed nations move up to a new stage at an average interval of 5 years. In China, it has been 38 years since China's power plant equipment manufacturing industry began manufacturing 6MW generators in Shanghai and we are still stuck at the subcritical generator level and our progress in raising grades from subcritical generators to supercritical generators has been slow.

Thus, to accelerate development of our electric power industry, we must rationally deploy large advanced high-efficiency generators. When building new power plants in east China, especially in coastal areas, 600MW and larger big supercritical generators should be the main generators to change the situation of backward electric power equipment and waste of coal resources.

During the Eighth 5-Year Plan and Ninth 5-Year Plan, China will add more than 10,000MW in new power generation capacity. Based on the situation in each region, we should combine not eliminating the development of medium-sized and small generators with major efforts to accelerate the development of large high-efficiency supercritical generators 600MW and bigger to make them the main force in all regional power grids.

Now, the basic conditions are in place for Shanghai to assume contractual responsibility for manufacturing 600MW supercritical generators: Shanghai's main plant buildings and equipment basically have the capability of manufacturing 600MW-grade thermal power and nuclear power generators and it has made important advances in work on shifting to domestic production and optimization of subcritical 300MW generators and holds a vanguard status within China in the area of developing supercritical generators. The two 600MW supercritical pressure generators imported at Shidongkou No 2 Power Plant are at advanced international levels of the 1980's. While importing the equipment, we have carried in the core technology for supercritical parameters. Developing and completing soft technologies, mainly key computer programs for boilers, steam turbines, and generators, would greatly improve efficiency and conserve foreign exchange and materials, and it would move design and manufacturing levels in China's power generator equipment manufacturing industry up to a new stage and make full preparations for our entry into the international market.

Comrade Gu Xunfang said that based on the requirements of the State Planning Commission and the Ministry of Energy Resources, Shanghai's comprehensive production capacity for power plants should be increased from the present 2,500MW a year to 4,500MW a year by 1995. Its value of output should increase from 5 billion yuan in 1992 to 10 billion yuan. At present, Shanghai should develop 600MW and larger generators as quickly as possible, especially 600MW supercritical generators, and use the No 3 and No 4 generators at Shidongkou No 2 Power Plant as the breakthrough point, which means ensuring the timely supply of generators that are technically advanced and operationally reliable to users and satisfying power use requirements, while at the same time spurring Shanghai's power plant equipment manufacturing industry to rely mainly on itself in conjunction with soliciting bids from foreign businesses and cooperative production and use integration of technology and trade to bring in integral technologies and form a supercritical generator manufacturing capability.

Shanghai's power plant industry should create name-brand products and have the boldness of vision to establish multi-province, multi-region, and multi-national enterprise groups, overcome the ideology of seeking stability and fearing risk, expand administrative cooperation and organize the relevant institutions of higher education and scientific research units in China to establish technology development centers and technical cooperation networks to strengthen our scientific research and development

capabilities, select the best large international companies with advanced technology as cooperative partners, use the market to replace technology and reduce our lag behind advanced international levels, and truly turn the power plant industry into a pillar industry.

To accelerate the development of supercritical generators, Gu Xunfang hopes that the relevant state ministries, commissions and offices will formulate the corresponding support policies.

Pact for Big Guangdong Plant Signed

40100091C Beijing CHINA DAILY (Economics and Business) in English 12 Jun 93 p 2

[Article by staff reporter Zheng Caixiong: "Power Plant Pact for Guangdong Is Signed"]

[Text] Guangzhou—Guangdong Province signed an agreement with three Hong Kong firms yesterday in Guangzhou to jointly construct and manage the Zhuhai Power Plant.

Located in the burgeoning West District of the Zhuhai Special Economic Zone bordering Macao, the first phase construction of the power plant is expected to cost $1.18 billion.

Guangdong investors, consisting of Guangdong Electric Power Holding Co. and Zhuhai Special Economic Zone Electric Power Group, accounts for 55 percent of the shares, while the Hong Kong partners, including tycoon Li Ka Shing's Cheong Kong Industrial Co., Ltd. and Hutchison China Trade Holding, hold the rest of the 45 percent of shares.

The first phase includes the installation of four 660,000 kilowatt generators.

Construction of the power plant started late last year. It is planned to be completed in the beginning of the Ninth 5-Year Plan (1996-2000), according to Yang Wenwei, an official from Guangdong Electric Power Holding Corporation.

Yang said that the thermal plant will import engines through public international bidding.

The power plant is designed to reach a capacity of 3.72 million kilowatts. And the second phase construction of the plant is expected to cost more than $2 billion.

The project is a key infrastructural project in the province in the period of 1991-95.

Huaneng, Zhejiang To Build Big Coastal Power Plant

936B0074A Hangzhou ZHEJIANG RIBAO in Chinese 17 Apr 93 p 1

[Article by reporter Sun Jieren [1327 0512 0086]]

[Text] The China Huaneng Enterprise Group, after assuming development of the entire first-stage development of the Ningbo Tax Free Zone, got repeatedly involved in Zhejiang's electric power construction. On the afternoon of 16 April, Vice Governor Chai Songyue, Zhejiang Electric Power Bureau Chief Zhang Weiwen, Huaneng Corporation President Wang Chuanjian, and Huaneng Electric Power Corporation President Yu Xinyang represented the two sides and signed a document of intent to join in a venture to build the Zhejiang Huaneng coastal power plant.

The Huaneng Enterprise Group has cooperated with Zhejiang in electric power construction projects since the early 1980s, including the joint venture construction of the two 200MW units for replacing coal with oil at the Zhenhai power plant, the three 26MW units at the Shitang hydropower station, two 125MW units at the Wenzhou power plant, and two 125MW units at the Changxing power plant. The Huaneng Electric Power Corporation's share of investment in the joint venture facilities, in terms of power generating capital, amounts to over 50MW. The completion of these projects has made an important contribution to easing the electric power crunch in Zhejiang and furthering Zhejiang's economic development, and a boon to the development of the Huaneng Enterprise Group, and it has planted a solid foundation for further cooperation between them.

This Huaneng Enterprise Group and Zhejiang's joint venture project, the Zhejiang Huaneng coastal power plant, is the largest joint venture construction project yet undertaken by the two sides. As expressed in the document of intent, this thermal power plant project, slated for late in the Eighth 5-Year Plan and in the Ninth 5-Year Plan, will have an installed capacity of two 600MW units in the first-stage at a total investment of about 5.5 billion yuan, of which Huaneng will hold 75 percent of shares, and proportionate role in construction and management.

After the signing ceremony, Zhejiang Governor, Wan Xueyuan, said the Provincial Committee and Provincial Government expect the goal of quadrupling the gross output value in 7 years to be reached ahead of schedule this year, and an 8-fold increase by 2000, and have designated construction of energy and transportation facilities to be the "force within a force" for economic construction, will strive to increase new installed capacity by 12,000MW in the next 8 years before the year 2000, and make Zhejiang the important secondary energy base in the east China area. To reach the above mentioned goals, not only must the people of the whole province work together, but even more support and assistance must be found within and outside the country. The Huaneng Enterprise Group is one of the bastions of corporate economic and technical strength in China. The many years of cooperation between Zhejiang and the Huaneng Enterprise Group have clearly shown that choosing Huaneng to be a long-range cooperative partner was correct and sound, and that the future of cooperation is great. It is sincerely believed that in the days ahead, cooperation between Zhejiang and the Huaneng Enterprise Group can be broadened and deepened.

Shen Zulun, Xu Yunhong and other provincial leaders attended the signing ceremony.

Coal Mines Aim at 1.5 Billion Tons by 2000

40100091A Beijing CHINA DAILY (Business Weekly) in English 7 Jun 93 p 1

[Article by Chang Weimin]

[Text] China's Coal Industry Ministry, which was officially re-established last week, is facing a series of tough challenges.

The industry, which employs 7 million people and produces 1.1 billion tons of coal a year, will have to push production up to 1.5 billion tons by 2000 to support the national economy.

The ministry was earlier dismantled and its functions were shifted to the former China National Coal Corporation and the former Ministry of Energy Resources.

The central government's decision to re-establish the ministry indicates the importance it attaches to the production of coal, which constitutes 74 percent of the country's energy consumption.

The industry had been operated under the rigid central planning for decades, but now has to conform itself to the market economy.

In addition, the industry has to become profitable as subsidies from the central government will be totally removed in 3 years.

Coal mines have been inefficient for decades due to artificially-low State-set prices for coal and poor management.

However, Wang Senhao, the Coal Industry Minister, is confident of fulfilling his mission, saying the industry will become profitable in 3 years.

Wang, who was the governor of Shanxi Province, China's largest coal producer, for 10 years, outlined the tasks for the industry in the next 5 years at a ceremony to mark the ministry's re-establishment in Beijing last week.

There are opportunities for the industry to quicken development as the reforms and open practices are being accelerated nationwide, Wang said.

He urged entrepreneurs from coal mines to turn their attention from only fulfilling State production quotas to working efficiently and turning out better economic results.

Mines are to meet market needs and must strive to achieve top economic efficiency, and all work should revolve around these goals, Wang said.

The ministry has made a package of programmes for adjusting the industry onto a fast, healthy development under the market economy.

The programmes include moves to:

—Liberalize the prices of coal to be produced in key State mines in accordance with market economic rules within 3 years;

—Close hopeless mines where production costs are too high and geological conditions are too poor to be improved;

—Transfer hundreds of thousands of workers from coal mines into coal processing and service industries to cut production costs;

—Build 100 high-yield mines with equipment both domestically-developed and imported from overseas.

Machinery systems capable of handling 2 million tons of coal or more are to be developed and manufactured.

Also, key technology and equipment will be introduced from overseas;

—Construct electric power stations near coal mines.

However, officials from the ministry said they will consult the Ministry of Power Industry to work out a co-operative plan.

Under the central planning economy for decades, coal mines had not been allowed to deal in the power generation business;

—Beef up coal processing and up-grade coal products;

—Rectify farmer-run coal mines, which have paid little attention to scientific exploitation of resources, environment protection and workers' safety;

—Draft a coal law so there will be unified yardsticks for tackling issues concerning efficient resources exploitation, environment protection and relations between coal mines and regional authorities;

—Make long-term coal mining development plans and related policies and measures for implementing the plans;

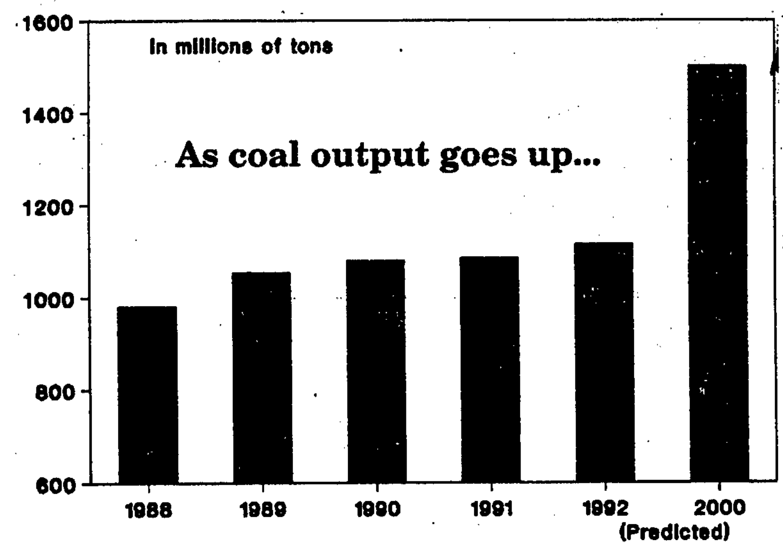
—Strengthen resources exploration and construction of efficient mines;

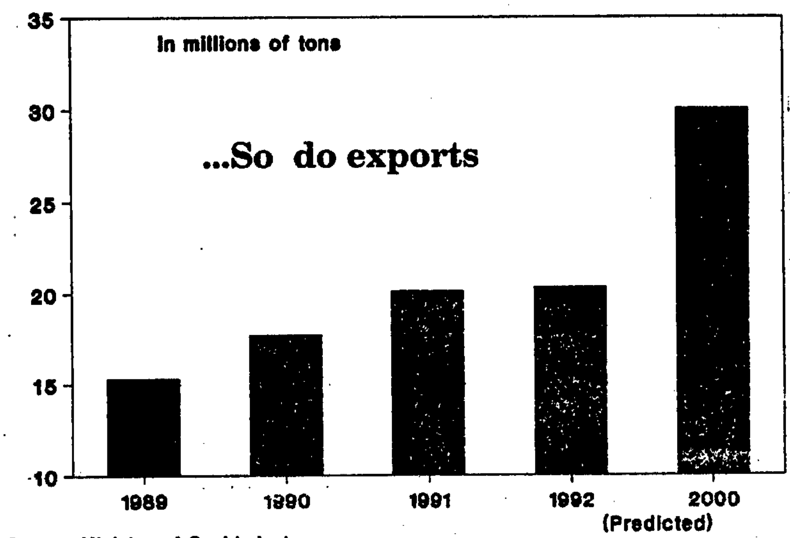
—Establish a network of coal exchange markets in accordance with the development of the national market economy.

Great attention should be paid to investigations and studies of the market and sales expertise;

—Beef up co-operation and technical exchange with the outside world;

—And closely follow the development of science and technology in the outside world and improve coal production by pushing forward technical progress.





Source: Ministry of Coal Industry

Construction of Shenfu-Dongsheng in Full Swing

40100091D Beijing CHINA DAILY (Economics and Business) in English 15 Jun 93 p 2

[Text] Construction of the Shenfu-Dongsheng coal field, expected to be China's largest, is in full swing.

The mine, stretching from the northern part of Shaanxi Province to the southern part of the Inner Mongolia Autonomous Region, is expected to be the core of China's coal production in the next century.

Reserves of 230 billion tons of coal have been verified, making the field one of the eight largest of its type in the world.

Verified reserves of coal in China total 1,000 billion tons.

China's annual production of coal, which constitutes 75 percent of energy consumption, is expected to reach 1.5 billion tons within 7 years from the present 1.1 billion.

China's large coal mines are concentrated in the central and northeastern part of the country but economists say the core will be in the western part of the nation in the next century.

Shenfu-Dongsheng, through years of construction, can already produce 10 million tons of coal a year.

The central government pins great expectations on the coal field, where geological conditions for mining are favourable and the coal is of high quality.

Projects for digging another 30 million tons of coal a year there are now under construction. In addition, preliminary work on projects for producing other 60 million tons of coal annually will begin soon.

The mine, to cost 33 billion yuan ($5.8 billion), will be built by the Huaneng Coal Corporation, a subsidiary of the China Huaneng Group. It is expected to be completed within 20 years.

1992 National Crude Oil, Natural Gas Output Figures Released

936B0052A Xining QINGHAI RIBAO in Chinese 30 Dec 92 p 2

[Article: "Big Breakthroughs in Crude Oil and Natural Gas Output, China's Petroleum Industry Steps Up to a New Stage"]

[Text] China's petroleum industry passed on some pleasing news today: our national crude oil output surpassed 140 million tons and natural gas output surpassed 15 billion cubic meters, moving up to a new stage in both areas.

The output produced in these two areas was 142 million tons of crude oil and 15.7 billion cubic meters of natural gas. This included production of 138.25 million tons of crude oil, an increase of 880,000 tons over 1991, and production of 15.1 billion cubic meters of natural gas, up by 200 million cubic meters over 1991, from the various oil and gas fields on the Chinese mainland. Marine petroleum output was 3.8 million tons and natural gas output was 600 million cubic meters, which were substantial increases over 1991. Bumper harvests were reaped in both continental and marine areas.

One important characteristic of our petroleum industry in 1992 is a significant improvement in development levels and balanced production levels at all oil and gas fields. Daqing Oil Field implemented the world's advanced technical measure of "stabilizing oil, controlling water" and produced 55.65 million tons during 1992, exceeding planned output by 250,000 tons and stabilizing output for 17 years at the 50 million-plus tons per year level. Shengli, Liaohe, and other oil fields exceeded the quotas in state plans.

The west China region was the primary region for increased crude oil output in China. While further reinforcing exploration and increasing reserves, Xinjiang's three big Tarim, Turpan-Hami, and Junggar basins also placed several new oil fields into development and construction in succession and there was a substantial increase in crude oil output. Including the other oil fields in west China, crude oil output in 1992 was 12.60 million tons, an increase of more than 1.2 million tons over 1991. This is an indication that new regions in west China have become a realistic region for resource replacement and output growth in China's petroleum industry.

Especially gratifying is that major advances were made in 1992 in natural gas exploration and development. Newly proven reserves grew more than two-fold over the plan, creating the highest level in history and completing increased natural gas reserve plans for the Eighth 5-Year Plan 3 years ahead of schedule. With approval by the state, Shaanbei [northern Shaanxi] Natural Gas Field was formally placed into development and a long-distance gas transmission pipeline was installed to transmit the natural gas to Beijing, Xi'an, Yinchuan, and other cities. We are also preparing to transmit natural gas from Turpan-Hami to Urumqi and transmit natural gas from Qinghai to Xining and Lanzhou to improve the fuel mix in these cities. China exported a total of more than 20 million tons of crude oil in 1992 and earned $2.6 billion in foreign exchange.

Update on Exploitation of Tarim Oil Fields' 5-Million-Ton Reserves

936B0052B Urumqi XINJIANG RIBAO in Chinese 5 Jan 93 p 1

[Article by reporter Zhao Hao [6392 1170]: "Five Million Tons of Petroleum Reserves Now In Hand at Tarim Oil Field, Exploration of Huge Structures Clearly Will Result In Significant Increases in Oil Output"]

[Text] On the afternoon of 4 January 1993, China Petroleum and Natural Gas Corporation general manager Wang Tao [3769 3447] and a group travelling with him exchanged views regarding the development situation in Xinjiang's oil and gas exploration and petroleum and chemical industries with Song Hanliang [1345 3352 5328] and other leaders of Xinjiang Uygur Autonomous Region.

After listening to situation reports from comrades from the Tarim Petroleum Campaign Headquarters, Xinjiang Petroleum Management Bureau, and Turpan-Hami Campaign Headquarters, Wang Tao gave a comprehensive speech. He described the takeoff in oil and gas exploration in Xinjiang's three big basins, including the Taklimakan, the situation for 10 major accomplishments that have been made, and the foci and ideas for future work.

Song Hanliang was very encouraged after listening to the introduction. He said the driving effect that petroleum and natural gas exploration and development would have on Xinjiang's economy would be incomparable to other industries. He thanked comrades on the petroleum battlefront who had contributed to Xinjiang's petroleum development and Xinjiang's economic development. He said that there will be substantial developments in petroleum and natural gas exploration and development during 1993 and that output would also be increased a great deal, and we must also make every effort as we have done before to ensure and support petroleum exploration and development. He also expressed some views concerning petroleum development and production in Xinjiang and the development of the petroleum and chemical industries.

Tiemuer Dawamaiti [6993 2606 1422 6671 3907 6314 2251], Jin Yunhui [6855 0061 6540], Wang Lequan [3769 2867 3123], Wang Yousan [3769 0645 0005], and others attended the meeting and expressed their views.

After a 3 year-long battle at Tarim, five oil fields have been proven at Lunnan, Donghetang, Sangtam, Jirak, and Jiefang [Liberation] Canal East. The reserve resources for 5 million tons of oil output required during 1995 by the state's Eighth 5-Year Plan are now basically in hand. Especially gratifying is that even larger fields for exploration have begun to be clear at China's largest huge structures, the western part of the Tazhong [central Tarim] structure and the eastern part of the Lunnan uplift. According to geological assessments and forecasts, the reserves of petroleum and natural gas resources in this

basin account for one-seventh to one-fourth of China's total oil and gas reserves, and its development prospects are extremely enticing.

100-Million-Ton Oil Field Discovered in Tarim Basin

936B0052C Beijing RENMIN RIBAO in Chinese 14 Jan 93 p 1

[Article by reporter Fei Weiwei [6316 0251 0251]: "Large Oil Field Discovered in Tarim Basin, Pleasing News on Oil and Gas Exploration in Western China, Reserves Exceed 100 Million Tons, Oil Strata Have Total Thickness of 42 to 98 Meters"]

[Text] Encouraging good news has been received from the Tarim Petroleum Exploration and Development Headquarters in China's Xinjiang with the recent discovery of a large integral oil field with reserves in excess of 100 million tons in the central part of Tarim Basin. This is the biggest discovery in the history of oil and gas exploration in Tarim Basin so far and is another major accomplishment achieved through adherence to the strategic principles of the CPC Central Committee and State Council for "stabilizing east China, developing west China" on the petroleum battlefront.

This oil field is located on the Tazhong [central Tarim] No 4 anticlinal structure located in the central part of the Taklimakan Desert. It has a total of three sets of oil strata, all of them Carboniferous system strata, and the oil strata have a total thickness of 42 to 98 meters. The Tazhong No 4 structure is located in the central structural zone of the Tazhong uplift region and has always been an important compass in oil and gas transport in its geological history. The experts are unanimous in the feeling that this region is a large oil and gas rich accumulation region and a primary battlefield in future searches for large oil and gas fields.

Characteristics of Natural Gas Reservoirs in China Reviewed

936B0045 Chengdu TIANRANQI GONGYE [NATURAL GAS INDUSTRY] in Chinese Vol 12, No 6, 25 Nov 92 pp 1-7

[Article by Qi Houfa [2058 0624 4099]* and Kong Zhiping [1313 1807 1627] of the China Petroleum and Natural Gas Corporation Petroleum Exploration and Development Scientific Research Academy: "Basic Characteristics and Accumulation Factors of Natural Gas Reservoirs in China"]

[Text] **Abstract** This article describes the basic characteristics of China's known gas reservoirs. On the basis of extensive analysis of geological conditions in 16 of our larger gas fields and in reference to the related information from foreign countries, we summarize the fundamental geological factors in the formation and accumulation of China's natural gas reservoirs.

Key terms: China, natural gas reservoirs, characteristics

Significant advances were made in the areas of theoretical understanding and exploration practice in research on natural gas through sustained attacks on key S&T problems during the Seventh 5-Year Plan and Eighth 5-Year Plan. However, our reserves of natural gas and increases in rate of output lag far behind the development requirements of our national economy. To alleviate the contradiction between natural gas supply and demand, evaluating exploration objectives should be given primacy in the area of geological research on natural gas. Doing work properly in this area requires an understanding of the basic characteristics of China's natural gas reservoirs and their accumulation factors.

I. Basic Characteristics of China's Natural Gas Reservoirs

By the end of 1989, China had discovered and formally registered 101 natural gas fields and 78 oil and gas fields, for a total of 179. Statistical analysis of these gas (oil) fields shows that the primary characteristics of the gas (oil) fields that have been discovered in China are:

A. Most gas (oil) fields are medium-sized and small in scale

Among our 179 gas (oil) fields, only 13 have geological reserves greater than 10 billion m^3 and the individual reserves in all 166 of the remaining gas fields are less than 5 billion m^3.

B. Our proven gas reserves are distributed mainly in the lower Tertiary and Triassic systems

Figure 1 shows that the Soviet Union's natural gas reserves are concentrated mainly in the Cretaceous system, which accounts for 77.6 percent of that country's total reserves. Natural gas in the United States is mainly distributed in the Tertiary system, which accounts for 42.7 percent of the national total. China's proven gas reserves are mainly in the lower Tertiary, which accounts for 25.12 percent, followed by the Triassic system and Carboniferous-Permian system.

C. In regional terms, they are distributed mainly in Sichuan and the Bohai Sea Basins

Our already discovered gas fields are mainly distributed in the Sichuan Basin, which contains 78.2 percent of China's total number of gas fields, and its proven reserves account for 49.3 percent of China's gas field reserves. Our oil and gas fields are mainly distributed in the Bohai Sea Basin, which accounts for 78.2 percent of our total number of oil and gas fields and 28.1 percent of China's total reserves.

D. The depth of burial of our gas (oil) fields is mainly in moderate and shallow strata

The depth of burial in 154 of our 179 already discovered gas (oil) fields is less than 3,200 meters and their reserves account for 79 percent of China's total reserves. One can see that moderate and shallow strata are the primary direction for China's natural gas exploration. The gas (oil) fields with a depth of burial greater than 3,200 meters are distributed mainly in the Sichuan and Bohai Sea Basins (Table 1).

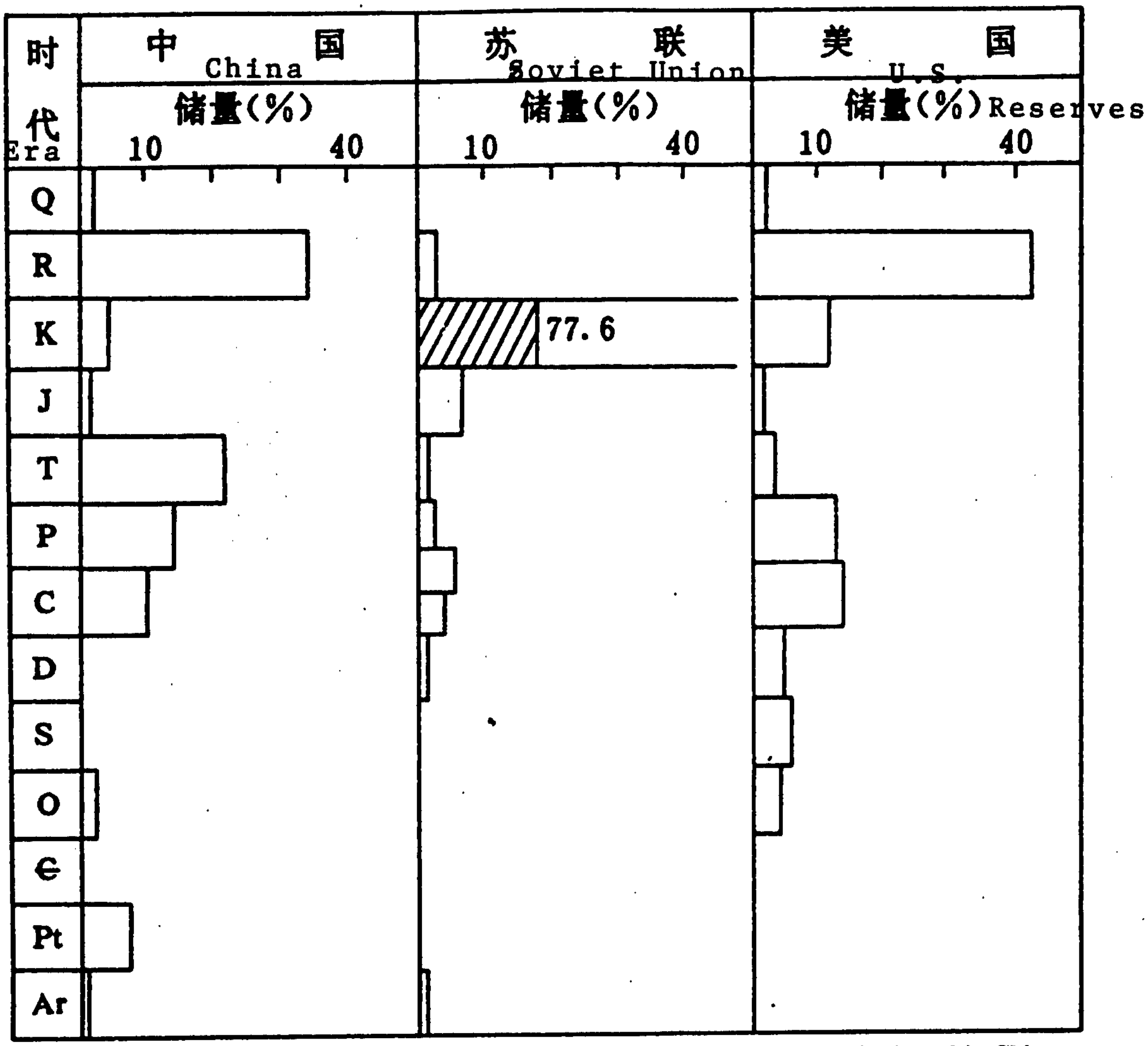


Figure 1. Comparison of the Strata Systems in Which Natural Gas Is Distributed in China, the Soviet Union, and the United States

Table 1. Depth Distribution of China's Known Gas (Oil) Fields

Depth of burial (m)	Number of gas (oil) fields	Percentage of total reserves
/h 1,500	54	15.30
1,500-3,200	100	64.09
3,200-4,500	22	14.62
> 4,500	3	5.99
Total	179	100

E. Gas reservoirs have a variety of gas sources

Based on statistics on the formational categories of natural gas, most of China's proven natural gas reserves are pyrolytic gas, which accounts for 49.5 percent of our total reserves and is mainly found in the Sichuan Basin. Oil-type gas accounts for 30.6 percent and is mainly distributed in the Bohai Sea region. Coal-formed gas accounts for 16.5 percent, and biogenic gas accounts for 3.4 percent. There is also a small amount of inorganically-formed non-hydrocarbon gas such as the Wanjinta CO_2 gas pool in the southern part of Songliao Basin, the Zhaolanzhuang H_2S gas pool in the Jizhong depression in the Bohai Sea Basin, and others.

F. Carbonate rock and clastic rock are of equal importance in natural gas pool reservoir strata

Most of the natural gas reservoir strata in the United States and Soviet Union are clastic rock, which accounts for 70.5 percent and 88.0 percent, respectively. In China, however, carbonate rock and clastic rock reservoir strata have roughly equivalent natural gas reserves, accounting for 53.8 percent and 46.1 percent, respectively. In addition,

metamorphic rock and granite reservoir strata also account for extremely small proportions.

In clastic rock reservoir strata, compacted sandstone reservoir strata account for a significant proportion, which is another important characteristic of China's natural gas reservoirs.

G. Fault-type and stratigraphic-lithologic traps account for a substantial proportion of our natural gas trap categories

According to incomplete statistics, fault-type and stratigraphic-lithologic traps together account for 51 of our 179 known gas (oil) fields, which is nearly 30 percent of the total number of gas (oil) fields. Anticlinal gas reservoirs are mainly distributed in the Sichuan Basin. If the gas reservoirs in Sichuan Basin are excluded from the statistics, non-anticlinal gas reservoirs account for an even larger proportion. This shows that the geological structures and trap categories of China's gas reservoirs are relatively complex.

H. Compound gas reservoirs are widely distributed

Compound gas reservoirs refer to gas pool combinations that have superimposed multiple gas-bearing strata groups and multiple trap categories. China's sedimentary basins have the structural characteristics of multiple cycles and multiple reservoiring and capping combinations and a variety of superimposed traps, and these provide the basic geological conditions for the formation of compound gas reservoirs. Many of the gas fields in the Sichuan Basin are composed of three or more superimposed gas reservoirs, and Wolonghe Gas Field is composed of a total of 10 gas reservoirs. Compound gas reservoirs are likewise widely distributed in the Bohai Sea Basin.

II. Accumulation Factors in China's Natural Gas Reservoirs

As was mentioned previously, most of the gas reservoirs that have been discovered in China are moderate to small in scale, and to date 16 of the individual gas fields (reservoirs) have reserves greater than 10 billion m^3. Conscientious summarization of the basic geological conditions for the formation and accumulation of these larger gas reservoirs has important practical significance for forecasting exploration directions for large and medium-sized gas fields.

A. Gas source rock on a substantial scale is the material foundation for the formation of larger gas reservoirs

Among the 16 larger gas (oil) fields listed in Table 2, the gas source rock is from coal systems in eight, lacustrine dark mudstone in four, marine facies muddy shale in one, and marine facies carbonate rock in four. It is apparent that coal-bearing strata systems, lacustrine (marine) facies mudstone, and carbonate rock can all become gas source rock for relatively large gas reservoirs. The key is that the gas source rock must have a significant scale, meaning that it must have a significant thickness and scope of distribution. The reason is that the formation of natural gas reservoirs can only occur when the amount of gas produced by the source rock is greater than the combination of the amount of gas absorbed by the rock, the amount of gas dissolved in the water (when the gas is associated with oil, consideration must also be given to the amount of gas dissolved in the oil), and the amount that is dispersed. One standard that can reflect the scale and quality of the gas source rock in a comprehensive way is the amount of gas generated per unit of area, meaning the gas generation intensity. Practice in exploration in China and foreign countries has shown that all large gas fields are distributed within a range having a rather great gas generation intensity. Table 2 shows that the thickness of the gas source rock in our 16 larger gas (oil) fields is generally > 200 m and that the gas generation intensity is generally > 2 billion m^3/km^2. Most of the region where the large gas fields in the Soviet Union's Western Siberia Basin are located have a gas generation intensity > 2 to 2.5 billion m^3/km^2, whereas most of the especially large gas fields are concentrated in a gas generation intensity range of > 6 billion m^3/km^2[1].

Table 2. Basic Geological Factors in the Formation

Number	Name of gas field (reservoir)	Trap			Source rock			Reservoir strata				
		Category	Area (km^2)	Elevation (m)	Era/lithology	Thickness (m)	Gas generation intensity (billion m^3/km^2)	Era	Lithology	Thickness (m)	Porosity (percent)	Permeability (10^{-3} μ^2)
1	Ya 13-1	Anticline	52.2	430	E/Coal system	50-480	4-6	E	Sandstone	130-290	14.9	215
2	Weiyuan	Anticline	850	895	Z/Carbonate rock	300	1	Z	Carbonate rock	70-100	3.22-3.26	1-38
3	Wolonghe	Anticline	176	-	Multiple sources	-	3.3-7.6	T-C	Carbonate rock	315-335	5-6	-
4	Moxi	Anticline	205.6	87	T/Carbonate rock	330	-	Tr	Carbonate rock	5-18	5.38-13.8	5-10
5	Kekeya	Anticline	31	450	Includes J/coal system	340	> 2	N	Sandstone	150	13.3-15.9	2-50
6	Wenliu	Anticline	18	> 200	C-P/Coal system	250	5.5	Es	Sandstone	102	12.5	3-5
7	Zhongba	Anticline	10.8 (Tr)	306	T_x/coal system, T_r/Carbonate rock	150-170, 600	5.	T_x, T_r	Sandstone, dolomite	175, 99-112	5-12, 2.4-5.5	0.1-14, 1-25
8	Xinglongtai	Fault block	104	-	E/Dark mudstone	860	3.3	E	Sandstone	-	18.6	1,789
9	Banqiao	Fault block	207.1	150	E/Dark mudstone	100-1,100	.35-.35	Es	Sandstone	50-250	14.1-17.8	137-182
10	Suqiao	Fault block	31	-	C-P coal system	200-400	3-4	0	Carbonate rock	120-180	2-3.3	-
11	Anticline	Jingzhou 20-2	30	70-320	E/Dark Mudstone	> 700	> 2	E	Continental clastic and raw clastic dolomite	12-35.8	1.76-24.9	0.21-49
12	Wangjiatun	Fault block	28	-	J/Coal system	350	6	K	Sandstone	86	16	0.2-258
13	Shengu	Fault-anticline	18	-	E/Coal system	400-500	-	E	Sandstone	149	10-16	0.1-35.4
14	Pinghu	Fault-anticline	-	-	E/Coal system	400-500	-	N	Sandstone	13.4-8.8	10-25	10-2,000
15	Tainan	Anticline	69.2	70	Q/Dark mudstone	1,100	-	Q	Powdery sandstone and argillaceous powdery sandstone	> 300	31	76-470
16	Shuangjiaba	Fault-anticline	7.5	-	S/Dark mudstone	350	2	C_2	Dolomite	20.1	5.5	-

of China's 16 Known Medium-Sized Gas Fields

Direct capping strata			Regional capping strata			Primary migration channel	Primary gas generation period	Primary reservoir formation period	Depth of burial (m)
Era	Lithology	Thickness (m)	Era	Lithology	Thickness (m)				
N	Argillaceous rock	290-370	N	Argillaceous rock	290-370	Unconformity	N-Q	N-Q	3,800
ε	Shale	100-300	S	Muddy shale	400-800	Unconformity	J	Himalayan period	3,000
T	Hard gypsum interbedded with mudstone	50-70	T-J	Argillaceous rock	> 1,000	Fault	J-K	Himalayan period	3,200 (P(infl))
Tr	Hard gypsum	6.6	T-J	Argillaceous rock	1,300	Sedimentary hiatus	J-K	Himalayan period	2,650
N	Argillaceous rock	n X 10	N	Argillaceous rock	> 300	Fault	N	Himalayan period	3,100-4,000
Es	Gypsum-halite	320-650	Es	Gypsum-halite	320-650	Fault	N	N	2,300-2,500
T_x, T_r	Argillaceous rock, dolomite	500, 100	T-J	Argillaceous rock	2,000	Fault	K	Himalayan period	3,000
E	Argillaceous rock	50-400	E	Argillaceous	400	Fault	N	N	1,240-2,800
Es	Argillaceous rock	400-500	Es	Argillaceous rock	400-500	Fault	N	N	2,800-3,900
C-P	Argillaceous rock	200-300	E	Argillaceous rock	300-600	Unconformity, fault	Himalayan period	N	3,800-4,200
Es	Calcareous mudstone	10-40	Ed	Argillaceous rock	400-600	Unconformity, fault	N	N	2,200
K	Mudstone	60-70	K	Argillaceous rock	> 600	Fault	K	K	1,700
E	Mudstone	-	E	Mudstone	170	Fault	N-Q	N-Q	3,660-3,810
N	Sandy mudstone	-	N	Sandy mudstone	170	Fault	N-Q	N-Q	2,308-4,271
-	Argillaceous rock	-	Q	Argillaceous rock	> 500	-	Q	Q	1,000-1,700
$P_1 1$	Shale	15	-	-	-	Unconformity	J-K	Himalayan period	4,500-5,000

B. Rather good reservoir strata are an essential condition for the formation of larger gas reservoirs

Natural gas has small molecules and powerful movement capabilities, so its requirements for the material properties of reservoir strata are not as high as those for petroleum, but relatively good reservoir strata are an essential condition for the formation of industrial gas pools, especially very large gas reservoirs. When the lower limit for the material properties of reservoir strata reaches a certain extent, although gas indications may be encountered during the drilling process and interpretation of well logs may indicate gas strata, industrial gas flows may never be obtained. Given China's conditions of reservoir strata material properties that are universally rather poor, this question should receive sufficient attention.

Among the 16 larger gas (oil) fields in Table 2, the lithology of the reservoir strata is sandstone in nine and carbonate rock in seven. With the exception of being slightly lower in the gas reservoirs of the Zhongba upper Triassic system Xu 2 segment (5 to 12 percent), the porosity of the sandstone strata in all of the other gas reservoirs is greater than 12 percent and the permeability is universally $> 3 \times 10^{-3}$ $>mm^2$. The sandstone reservoir strata in the large and especially large gas fields in foreign countries generally have a porosity > 15 percent and a permeability $> 5 \times 10^{-3}\ \mu m^2$ (Table 3).

Table 3. Data on the Material Properties of Certain of the World's Huge Gas Fields

Name of gas field	Amount reservoired (million m^3)	Strata period	Lithology	Depth of burial (m)	Porosity (percent)	Permeability ($\times 10^{-3}\ \mu m^2$)
(Wuliangeyi)	780	Cretaceous	Sandstone	1,100-3,550	11-21, maximum 27	43-116, maximum 459
(Yameibao)	400	Cretaceous	Sandstone	1,004-5,177	15-18, maximum 27	15-18, maximum 470
(Geluoningken)	250	Lower Permian	Sandstone	2,800-3,000	15-20	115
(Panhande-Huguopin)	200	Permian	Limestone, sandstone	1,250-1,920	10-15	1-5
(Haxilemaner)	153	Triassic	Sandstone	2,130-2,400	16	30-500

At present, the reservoir strata in the larger carbonate rock gas reservoirs in China all have rather poor material properties with porosities generally of 3 to 5 percent and most have permeabilities of about $2 \times 10^{-3}\ \mu m^2$.

Making a correct determination of the lower limits of the material properties of the reservoir strata in industrial natural gas reservoirs is very important for exploration work. Besides being related to geological conditions, the value of this lower limit is also affected by technical levels, so it is very difficult to establish a general-purpose standard. This article uses actual exploration experience and real analytical data from Dongpu and several other regions as a basis for an initial derivation that when porous reservoir strata have a fissureless configuration or have not undergone effective artificial pressure cracking measures, the lower limits for the output of industrial gas flows are a porosity of 10 percent and a permeability of $1 \times 10^{-3}\ \mu m$. When fissures exist, the lower limit of the porosity of reservoir strata can be reduced substantially. The upper Triassic system compacted sandstone in Sichuan Basin, for example, has a porosity of about 6 percent and because it has fissures it also produced an industrial gas flow[2].

C. There must be excellent regional capping strata

Natural gas can migrate and disperse in a permeation mode via large fissures and connected pores, and it can migrate and disperse in a diffusion mode[3]. Computations indicate that the effects of dispersion of natural gas in geological history can destroy industrial gas reservoirs that have formed. Thus, the formation of gas reservoirs, particularly the formation of large gas reservoirs, requires excellent regional capping strata. With the exception of Wenliu gas reservoir, which has gypsum-halite strata, the other 15 regional capping strata listed in Table 2 are argillaceous rock strata and all have a thickness > 300 meters. When regional capping strata are present, the direct capping strata that form gas reservoirs do not have to have great thicknesses. For example, the calcareous mudstone that is the direct capping strata at Moxi gas reservoir is only 10 to 40 meters. On the other hand, if there are no excellent regional capping strata, even if there are good direct capping strata, it is not necessarily certain that natural gas accumulations with industrial value will have formed. For example, although the Yanxin (P_1 gas-bearing strata) at Weiyuan Gas Field have the Longtancoal system, which is about 150 meters thick, as direct capping strata, because the Triassic system Xi-3 segment carbonate rock outcrops at the surface there are no regional capping strata, and the result is that only residual gas distributions have been discovered at the high points of structures and no rather large industrial accumulations formed.

When evaluating the sealing capabilities of capping strata, the effects of dispersion are a factor that cannot be ignored, and full consideration must be given to the nonhomogeneity of the lithology of capping strata in thevertical and horizontal directions. Thus it is not appropriate for a determination of the sealing capabilities of capping strata to be made simply on the basis of experimental data on the fracturing pressures of a few samples. Instead, multifactorial analysis based on the lithology, thickness, porosity, depth of burial, hydrocarbon concentration, and so on of the capping strata must be carried out.

D. Paleouplifts and early traps are conducive to the formation of natural gas pools

Traps that are formed prior to or at the same time as the primary period of natural gas generation and migration are

beneficial for the accumulation of gas. Conversely, traps that formed during later periods are not conducive to the accumulation of gas or are basically incapable of forming industrial gas reservoirs. Local structural traps in the Sichuan Basin formed during late periods (mainly during the Himalayan period), which has become an unfavorable factor for the accumulation of natural gas in this basin. However, several large paleouplifts in the Sichuan Basin have played a significant role in the accumulation of gas. For example, the Caledonian period Leshan-Longnusi paleouplift had an obvious controlling effect on the formation of Weiyuan and Moxi Gas Fields. The Luzhou-Kaijiang paleouplift played a role in the accumulation of Permian system-Triassic system gas reservoirs in southern Sichuan and Carboniferous system gas reservoirs in northern Sichuan. Zhongba Gas Field in northwestern Sichuan is closely related to ancient folded traps from the Indosinian period.

E. Later peak gas generation periods and pooling periods are more conducive to the formation of larger gas fields

Natural gas has a powerful dissipation capability and later peak gas generation periods and pooling periods mean a short dissipation time. Under identical geological conditions, as a result of dynamic equilibrium of underground natural gas, more free gas may be preserved and accumulate into reservoirs and there may also be a corresponding reduction in the amount of already-pooled natural gas that dissipates, which is favorable for the formation of larger gas fields.

Statistics show that the peak gas generation periods in 10 of our 16 larger gas (oil) fields were in the Tertiary-Quaternary eras and five were in the Jurassic-Cretaceous eras, while only the Weiyuan Gas Field was in the Triassic era. It is apparent that most of the larger gas fields that have already been discovered have later peak gas generation periods. Ya 13-1 Gas Field has large reserves and a high degree of filling, and its late gas generation period (late Tertiary-Quaternary) is one of the main factors. In contrast, Weiyuan Gas Field had an early peak gas generation period, which is one of the main reasons for this gas field's low degree of filling (just 25 percent).

The most typical example of a late reservoir formation period is Tainan Gas Field. The mudstone capping strata in this gas field have a relatively high porosity and a permeability of (0.4-1.4) X 10^{-3} μm^2 as well as a high dissipation capability, but this gas field is still a relatively large gas field with an accumulation of several 10 billion cubic meters. The primary reason is that it had a late reservoir formation period (Quaternary) and is still in the process of continually generating and reservoiring natural gas. With the exception of Wangjiatun Gas Field which had a relatively early reservoir formation period (Cretaceous), all of the other 15 of the 16 larger gas (oil) fields listed in Table 2 are from the Himalayan period.

F. Faults and unconformities play important roles in the accumulation of natural gas

Faults and unconformities play important roles in three areas in the formation and accumulation of natural gas reservoirs:

1. Faults and unconformities play a role in occlusion and enclosure, forming fault-type and stratigraphic traps, respectively, that provide the entrapment conditions for the formation of natural gas reservoirs.

2. They can effectively improve the reservoiring properties of reservoir strata. The important role of faults and their associated fissure systems in improving compacted reservoir strata has been confirmed by a large amount of exploration practice. For example, 48 of the 67 gas wells in the upper Triassic sandstone reservoir strata in the central and western parts of Sichuan Basin relied on fissures for their gas output, equal to 72 percent of the original number of gas wells. This is also the case for the carbonate rock reservoir strata in Sichuan Basin, where high output wells are closely related to strong structural stresses, the high point axial locations where fissures developed, and fault-fracture zones. Dissolution leaching of unconformities played a substantial role in improving their reservoiring properties.

3. Faults and unconformities can link multi-source and distant-source natural gas that accumulates to form relatively large gas fields. At Wolonghe Gas Field, for example, multiple faults in the axial portion linked together multi-strata gas sources beneath them to the lower Triassic Jia 5^2 ($T_1c^5{}_2$)-Jia 4^3($T_1c^4{}_3$) segment to form gas reservoirs with relatively large reserves. Jingzhou 20-2 Gas Field relied on unconformities and faults to link up with the "distant-source natural gas" in the Liaozong depression of its northeast-striking structures to form gas reservoirs will relatively large reserves. The natural gas migration indicators shown in Figure 2 clearly shown this type of migration route.

In the 16 larger gas (oil) fields in Table 2, 14 are related to fault-fracture unconformities, which is an indication of their important role in the formation of large gas fields.

G. When there was severe dissipation in ancient periods, the effects of secondary gas generation are a decisive factor in the formation of gas reservoirs

During the natural gas generation and migration processes, sedimentary hiatuses or strata uplifting may occur prior to the sedimentation of regional capping strata, or strata uplifted after sedimentation of regional capping strata may be eroded. All of these things can result in dissipation of large amounts of natural gas to the extent that it dissipates in its entirety. In a situation in which this type of severe ancient dissipation has occurred, the effects of secondary gas generation due to large-amplitude subsidence during later periods have an important relationship to the formation and accumulation of gas reservoirs. The formation of the two large gas fields at Wenliu and Suqiao are closely related to the effects of secondary gas generation by the Carboniferous-Permian coal systems in this region[4]. Indosinian activity in this region caused widespread uplifting of the strata and the coalification and gas generation processes of the Carboniferous-Permian coal systems were interrupted, which made preservation of the natural

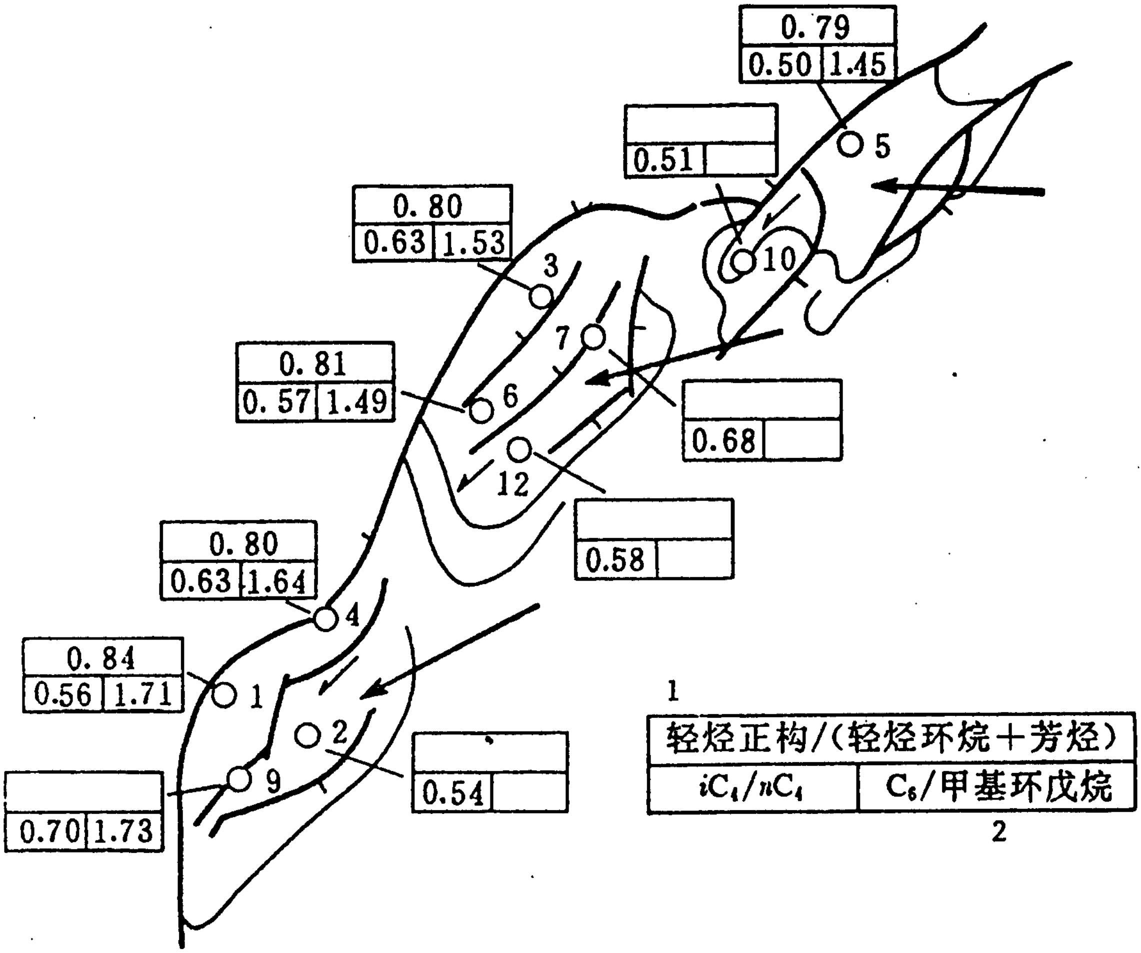


Figure 2. Direction of Natural Gas Migration in Jingchuan 20-2 Gas Field (According to the Bohai Sea Petroleum Company Research Academy)

Key: 1. Light hydrocarbon normal structure/(light hydrocarbon napthene + aromatic hydrocarbon); 2. C_6/methyl-cyclopentane

gas that was generated during early periods difficult. When the large-amplitude subsidence during the Mesozoic and Cenozoic exceeded the depth of ancient burial prior to the Indosinian period (about 3,500 m), secondary gas generation occurred and only then did the natural gas that was generated during the secondary gas generation process have real significance for the formation of gas reservoirs. This is confirmed by the fact that the two rather large gas reservoirs at Wenliu and Suqiao are both found in the region where the Carboniferous-Permian systems had a gas generation intensity of > 1 billion m^3/km^2. The formation of Yakela oil and gas field is closely related to the effects of secondary hydrocarbon generation by the Manjiaer depression's Cambrian-Ordovician carbonate rock hydrocarbon source rock. Oil and gas was generated and reservoired prior to the late Hercynian period in this region, and after uplifting and erosion of the Paleozoic strata during the Hercynian orogeny, the petroleum became condensed after oxidation and biocatabolism, and large amounts of the natural gas dissipated, so only oil reservoirs with a low oil/gas ratio and large petroleum density could form (such as the Lunnan region's Ordovician weathered crust crude oil). Following continual subsidence of the Mesozoic and Cenozoic strata, the oil and gas fields that were generated migrated toward Xayar uplift and accumulated, resulting in the formation of Yakela Oil and Gas Field which now has a high oil/gas ratio. In foreign countries, the role of secondary gas generation was also very important in the formation of the large gas field at (Geluoninggen) in the southern part of the North Sea Basin[5].

H. The effect of disassociation of water-dissolved gas in strata during uplifting or upward migration is an important geological factor in the formation of gas reservoirs

The results of natural gas attaining equilibrium in strata water because the intensity of the initial gas generation was not sufficiently great or because of serious ancient dissipation may result in natural gas

not being able to attain a super-saturated state in strata water and be incapable of being freed gas that forms into gas reservoirs. Only by relying on uplifting of strata during later periods or the upward migration of water-dissolved gas (vertical migration along fractures and migration along the upward sloping surfaces of reservoir strata) can the natural gas be disassociated from the strata water and accumulate into reservoirs under suitable conditions. Preliminary analysis indicates that the formation of Weiyuan Gas Field may have undergone this type of geological effect (Figure 3).

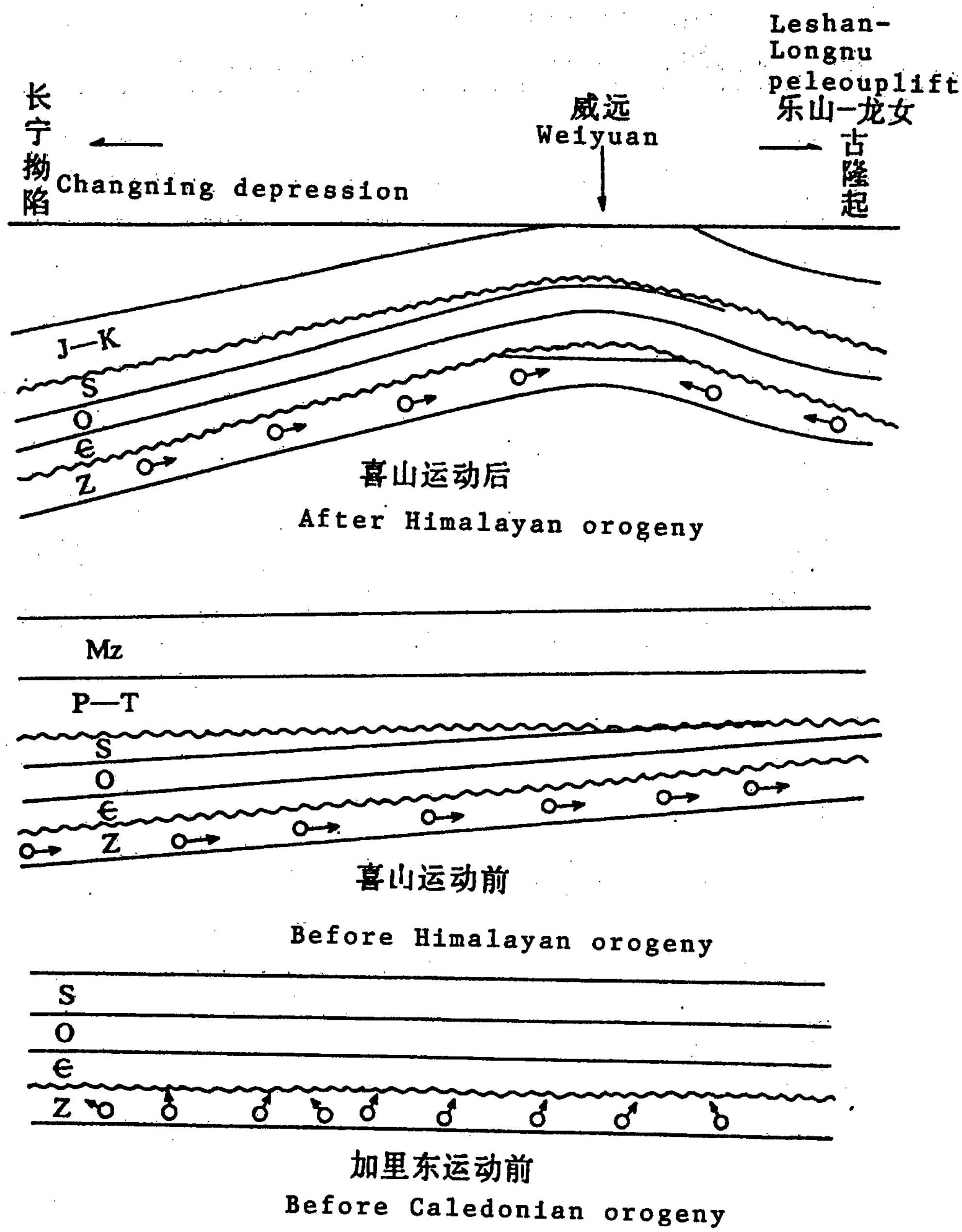


Figure 3. Illustration of Reservoir Formation Process at Weiyuan Gas Field

According to analysis of the paleostructural development at the top surface of the Sinian system and the organic matter hydrocarbon formation history, the Leshan-Longnusi paleouplift was formed at the end of the Caledonian period and continued developing during the subsequent movements in the Hercynian, Indosinian, and Yanshan periods, and now the Weiyuan structure has been on the southeastern slope of the paleouplift for a long period and was not compressed, folded, and uplifted until the Himalayan orogeny to become a large domed anticline. The organic matter in the Dengying group hydrocarbon source rock began to mature at the end of the Silurian era and attained its oil generation peak at the end of the Permian, and nearly all of it had been pyrolized into gas at the end of the Jurassic. This shows that during its peak natural gas generation period, the Weiyuan structure was still in the southeastern slope region of the paleouplift. The modern Weiyuan Dengying group gas reservoir is a low water and very large volume block-shaped gas reservoir. Based on computations by Liu Fanghuai [0491 2455 2849], this structure has a gas-bearing rock volume of 26.28 billion m^3. In addition, its lower parts have a water-bearing rock volume of 479.825 billion m^3 and a groundwater volume of 13.606 billion m^3. Computed on the basis of this gas reservoir currently having a water-dissolved gas coefficient of 2.19 m^3/m^3, the amount of gas dissolved in the groundwater within the scope of the structural trap is about 30 billion m^3, equal to ¾ of the proven reserves of Weiyuan gas reservoir. Extrapolating from this, the volume of the water in the strata of the southeastern slope region of the late Jurassic paleouplift is relatively large and the natural gas it generated may be preserved mainly in a water-dissolved state in the strata and may have undergone regional migration toward the Leshan high point region of the paleouplift at that time. Only after the Himalayan orogeny caused upward folding of the Weiyuan region into a domed structural trap and because it was uplifted by a relatively large amplitude (prior to folding, the Weiyuan region was about 100 meters lower than the Leshan high points, while after folding the Weiyuan structure was 1,800 meters higher than the Leshan region) did the natural gas dissolve out of the strata water and migrate toward the Weiyuan structure and accumulate into gas pools. This was another primary reason for the large water body and low degree of natural gas filling of this gas reservoir.

It goes without saying that the eight basic geological factors related to the formation and accumulation of natural gas do not act independently and that larger gas fields can only form when they occur together. China's largest in terms of proven reserves, the Ya 13-1 gas field, is the best example. This region has developed gas source rock with a gas generation intensity near the gas field of 4 to 6 billion m^3/km^2, a great thickness of sandstone gas reservoir strata (total thickness 110 to 183 m), a porosity of 10 to 20 percent, and a permeability of 5 to 500 X $10^{-3}\mu m^2$. It deserves special mention that in a situation of the existence of relatively large traps from earlier periods (covering an area of 52.2 km^2) and excellent regional capping strata (argillaceous rock 290 to 370 m thick), the large-amplitude rapid subsidence of the Pliocene-Quaternary (amplitude > 300 m) played a particularly prominent role in accelerating the course of thermal evolution of the gas source rock, the generation of large amounts of natural gas and the ability to preserve it very well, and ultimately accumulate into a large gas field.

III. The Prospects for Natural Gas Exploration in China

Although the natural gas that has been discovered in China at the present time is mainly medium-sized and small gas fields and China's total proven natural gas reserves are not large, there are excellent prospects for natural gas in China.

The geological conditions of China's natural gas are rather complex, but we have relatively abundant natural gas resources, with the total amount of China's natural gas resources forecasted by different units during the Seventh 5-Year Plan being 3.3 to 4.3 billion m^3. In their attacks on key problems during the Sixth 5-Year Plan and Seventh 5-Year Plan, natural gas geological workers have consistently felt that the large basins of the central and western parts of the Chinese mainland and large continental shelf basins in our marine regions all have the basic geological conditions for the formation of large gas fields. Significant achievements have been seen in a preliminary fashion in exploration work during the Seventh 5-Year Plan and nine gas fields with reserves > 10 billion m^3 have been discovered. This is particularly true of the discovery of natural gas in the Ordovician weathered crust in the central part of the Shaan-Gan-Ning [Shaanxi-Gansu-Ningxia] Basin and the excellent natural gas indications in the Ying-Qiong Basin, the central part of the Junggar Basin, and the Tu-Ha [Turpan-Hami] Basin that are providing increasingly clearer indications of the excellent development prospects for China's natural gas. With correct technological ideas, proper policies, and work pushing forward, we will certainly be able to make even greater breakthroughs and advances in natural gas exploration during the Seventh 5-Year Plan.

*Box 910, Academy of Sciences Road, Beijing Municipality 100083

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Time to Analyze Exploration Data Reduced to 2 Hours

936B0076B Shanghai JIEFANG RIBAO in Chinese 9 Apr 93 p 2

[Article by reporter Li Hongwen [2621 1347 0251]]

[Text] In the past, it took one month of labor-intensive work to complete a sectional analysis of the oil and gas prospecting areas in China, but now, with the advent of basin tectonic evolution modelling systems, the task can be completed in only 2 hours.

That is how the research for key projects of the Eighth 5-Year Plan was done cooperatively by the scientific researchers of the Marine Petroleum Prospecting and Development Research Center and the China University of Geology (in Beijing), which has now passed examination and acceptance in Beijing. Experts believe this feat, accomplished for the first time in China, is up to advanced international standards.

For a long time, the big problem for Chinese land and sea oil and gas prospecting has been how to rapidly and accurately process the large volume of complex seismic sectional data. Doing the analysis manually, as in the past, consumed much time, and was inefficient and imprecise. Whereas the new system, when applied to over 30 oil and gas well drilling appraisals and inspection findings in the East China Sea area, increased the ratio of forecasted results that tallied with the actual drilling situation from what was 20 percent by manual processes, to over 70 percent, raised the working efficiency rate by a factor of several dozens, greatly enhancing the prospecting success rate, and lowering oil and gas drilling investment risks.

Oil, Gas Exploration in Three Major Xinjiang Basins Stepped Up

936B0052D Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 27 Jan 93 p 1

[Article by Shen Zunjing [3947 1415 2417]: "Exploration and Development Flying Ahead in Xinjiang's Three Big Basins, 1993 Output 8.77 Million Tons of Oil and 700 Million Cubic Meters of Natural Gas"]

[Text] In Xinjiang's three big Junggar, Tarim, and Turpan-Hami basins, old oil fields are full of vigor, new oil fields are rising quickly, and a pleasing situation of surging petroleum exploration and development has appeared. In 1993, these three basins produced a total of 8.77 million tons of crude oil and 700 million cubic meters of natural gas, and their crude oil output was up by more than 1 million tons over 1992.

There were three good reports from Xinjiang's petroleum industry as 1993 began. A large integral oil field with reserves in excess of 100 million tons was discovered in the central part of the huge Taklimakan Desert, two high-output oil and gas wells were drilled in Junggar Basin, and a new oil field and a new oil and gas accumulation zone covering an area of 4,000 square kilometers were discovered.

Xinjiang's three big basins cover a total area of about 740,000 square kilometers and contain nearly one-fourth of China's total oil and gas resource reserves. Chinese and foreign experts have called them the "Sea of Hope" for China's petroleum industry. Through the arduous efforts of Xinjiang's several 100,000 petroleum employees, oil and gas exploration and development in these three big basins has stepped into a golden era.

Karamay Oil Field, which has been exploited for nearly 40 years, instead of regressing in the past 10 years has also expanded the area of its oil field to the eastern part and central region of the basin's northwestern margin, its proven reserves have increased every year, and its crude oil output has increased every year. Now, yearly output from Karamay has held stable at fourth place among China's nearly 20 oil fields and has earned a reputation as a "younger and younger" oil field.

In the 560,000 square kilometer Tarim Basin, more than 3 years of arduous battle by staffs in the battle for petroleum have produced oil and gas discoveries and major discoveries in 29 structures and proven six integral oil and gas fields at Lunnan, Donghetang, Jirak, and other places. Lunnan Oil Field, which is first-rate in China, has now been completed and has a yearly output capability of 1 million tons. Sangtam Oil Field, another field with a yearly crude oil output of 300,000 tons is now basically completed.

Although Turpan-Hami Basin covers a small area and oil and gas exploration and development started relatively late, it has moved ahead at great speed. In just 2 years of battle, five oil fields have been discovered. In 1992, oil output from Turpan-Hami Oil Field increased nearly 2-fold over 1991 and is projected to reach 1 million tons in 1993.

Bohai Update: Three Fields Each With 400,000 Tons Annual Production

936B0076A Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 4 May 93 p 2

[Article by reporter Zhang Hongwen [1728 1347 2429] and intern Man Xuejie [3341 1331 0267]]

[Text] Tianjin, 4 May (XINHUA)—China has made impressive gains through its independently managed petroleum prospecting and development operations in Liaodong Bay. In these waters one gas field is already into production, one oil field is about ready and another is under development.

At Bohai oil fields which have been under development in cooperation with Japan since 1979, there are three modernized offshore oil fields now operating, each with a planned annual production capability of 400,000 tons. Since 1987, a "concurrent cooperative and independent operations" policy has been in effect in the Bohai, and

offshore oil fields in Liaodong Bay have been independently prospected and are under development using advanced foreign management, technology, and imported modern facilities.

The independently managed oil and gas fields in Liaodong Bay area of the Bohai: the Jinzhou 20-2 condensate oil and gas field, Suizhong 36-1 oil field, and Jinzhou 9-3 oil field, have geological reserves containing over 200 million tons of crude oil, and nearly 20 billion cubic meters of natural gas, and comprise the largest offshore independently managed oil and gas development and production area in China.

Jinzhou 20-2 condensate oil and gas field can be reached by ship in two hours travelling northwest from Huludao. This is China's first offshore oil and gas field to go into production. Its seven production wells have a designed annual output capability of 500 million cubic meters, a daily natural gas output of 1.4 million cubic meters and 300 cubic meters of oil condensate. Since test production began last November, the cumulative output of natural gas has been over 120 million cubic meters.

Southwest of the oil and gas field, 80 miles away, is China's largest offshore oil field, Suizhong 36-1. Its two production platforms and one dynamic powered platform are completed and expected to go into formal operations this August. The test area of this oil field is 6.55 square kilometers, and its geological oil reserves are nearly 50 million tons with a designed annual output of 1 million tons. Each of the two production platforms have 16 production wells.

The Jinzhou 9-3 oil field is now under development. Authorities in charge of this oil field project say the oil field has 30 million tons of geologic oil reserves, is designed for annual output of 600,000 tons, and is expected to become operational in 1997.

China's successful use of its own high-tech marine petroleum advancements in the development of its independently managed oil and gas fields in Liaodong Bay has caught the attention of foreign interests.

Marine petroleum experts believe that the full-scale development of Liaodong Bay oil and gas area signal China's entry into an era of independent development of marine petroleum.

Nation's Largest Offshore Oil Field Being Developed

936B0073B Beijing RENMIN RIBAO in Chinese 18 Apr 93 p 1

[Text] Guangzhou, 17 Apr—China Offshore Petroleum Hainan Eastern Corporation has announced that China's largest offshore oil field, the Liuhua 11-1 oil field, has been approved by the Chinese Government for full-scale development, and construction is formally underway.

Liuhua 11-1 oil field was discovered in January 1987 through a combined prospecting effort by the China Offshore Petroleum Hainan Eastern Corporation and Amoco Eastern Petroleum Corporation. It is located in the 29/04 contract zone, 220 kilometers from Hong Kong. The total area of development is 317 square kilometers, and the controlled petroleum geological volume is 233 million cubic meters, the largest Chinese offshore oil field discovered to date. The No 1 zone deposit to be exploited is a 14.4 square kilometer area with a volume of 97.63 million cubic meters at an investment of 653 million U.S. dollars. The oil field is expected to go into operation in 1996 and be productive for 15 years with a peak annual output of 1.68 million tons.

The China Offshore Petroleum Hainan Eastern Corporation holds 51 percent of the shares in the development of the oil field, and Amoco Eastern Petroleum Corporation holds 49 percent.

New Oil-Bearing Geological Structures Discovered in Western Bohai

936B0052E Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 4 Feb 93 p 1

[Article by Man Xuejie [3342 1331 2638]: "Exploration in Western Part of Bohai Sea Discovers China's Largest Marine Oil Field with Reserves of 190 Million Tons"]

[Text] More new advances were made during 1992 in exploration of Bohai Oil Field with the discovery of new oil-bearing structures that had lain dormant for many years were discovered in the marine area of the western Bohai Sea that have added nearly 100 million tons in geological petroleum reserves.

In 1992, the Bohai Petroleum Company made major advances in evaluation of the Suizhong-36 oil field which will be going into operation. By drilling 32 development wells, doing detailed research on the characteristics of oil pools, and exploratory drilling of 3 evaluation wells, they increased the controlled reserves of the two platforms in region A of this oil field from 28.71 million tons to 39.88 million tons, a 39 percent increase. Added to the newly proven 16.46 million tons around the edge of the northern boundary and the newly proven 13.45 million tons around the edge of the southern boundary, the basic proven reserves at Suizhong-36 Oil Field have risen from 120 million tons to 190 million tons, making it the largest marine oil field discovered so far in China.

In several old exploration regions, Bohai Oil Field has destroyed the dormant situation in the western marine areas of Bohai Sea during the past several decades. Drilling of the Qikou-18-1-1 well has been completed and it has geological petroleum reserves of 12 million tons.

Natural Gas Discovered in Yunnan's Songming County

936B0052F Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 16 Feb 93 p 1

[Article by special reporter Li Liusan [2621 0362 0005]: "Natural Gas Drilled at Bazi in Songming, Yunnan Ends the Historical Absence of Natural Gas Wells in Yunnan"]

[Text] A major breakthrough has been made in long-dormant natural gas exploration in Yunnan at Bazi in

Songming. The Yunnan-Guizhou-Guangxi Petroleum Exploration Bureau Third Company First Gas Well Team had a gas eruption at the "Yangjian No 1" well, which ended the historical absence of natural gas wells in Yunnan.

I visited Fudu Village in Yanglin Township in the central zone of Bazi in Songming on the morning of 10 February 1993, where I observed the "Yangjian No 1" well which had been sealed by the drilling workers. At the site, First Gas Well Team deputy team leader Hu Jianyun [5170 1696 0061] told me that they had started drilling on 26 June 1992 and had discovered their first gas stratum when they had drilled to a depth of 198 meters. When they had completed drilling to 550 meters, they had detected a total of 5 gas strata, and the gas strata had a total depth of 49 meters. When they drilled into their third gas stratum, a gas eruption also occurred and the height of the gas eruption was greater than the drilling rig, more than 20 meters. The total gas pressure of the first gas strata was greater than three atmospheres. Evidently, the natural gas could be put into use merely by removing the water from the well.

The gas eruption from the "Yangjian No 1" well presages the prospects for developing natural gas at Bazi, Songming 60 kilometers from Kunming. For additional proof of the reserves, the Yunnan-Guizhou-Guangxi Petroleum Exploration Bureau will deploy 10 wells around this well during 1993, four of which will be producing wells and six will be exploratory wells.

880-Kilometer-Long Submarine Gas Pipeline Planned

936B0074B Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 27 Apr 93 p 1

[Article by reporter Lu Peifa [7120 1014 3127]]

[Text] Beijing, 26 Apr—The China National Metallurgical Products Import and Export Corporation won the bid to build an 880-kilometer submarine natural gas pipeline, the Nanhai - Hong Kong submarine natural gas pipeline project, for which China, Japan, and the U.S. were signatories at a grand ceremony in Beijing on 24 April 1993.

Experts say this project, which is the second longest natural gas pipeline project in the world, will get underway this year, and plans are for it to begin transporting gas on 1 January 1996.

The Nanhai - Hong Kong submarine natural gas pipeline project, approved by the State Council, is a joint venture by the China Offshore Petroleum Corporation, U.S. - Arabian - Kuwait China Corporation, and Kuwait Overseas Petroleum Prospecting Corporation, for which, the U.S. - Arabian - Kuwait Corporation circulated the bids. The pipeline will have two segments" a 780- kilometer segment from Yacheng to Hong Kong, and a 100-kilometer segment from Yacheng to Hainan island. The two segments together will require 240,000 tons of welded seam pipe at a cost of 190 million U.S. dollars, all of which will be purchased from Japan by the China National Metallurgical Products Import Export Corporation. Once the gas field goes into production, the volume of gas transported to Hong Kong and Hainan island via the two segments annually will be 2.9 billion cubic meters and 500 million cubic meters respectively. This project will play a large role in solving the energy needs of Hong Kong and Hainan island.

Three Fields Discovered/Confirmed in East China Sea

936B0076B Shanghai JIEFANG RIBAO in Chinese 9 Apr 93 p 2

[Article by reporter Sang Puquan [2718 2528 3123]]

[Text] The Shanghai Marine Geology Investigation Bureau celebrated the 20th anniversary of its founding on 8 April, and Bureau Chief, Gu Zongping, announced that the "Pinghu", "Canxue", and "Yuyunting" oil and gas fields and 14 oil and gas bearing structures have been found and confirmed in the East China Sea, and development of oil and gas fields there is already underway.

It was learned that for 20 years the Shanghai Marine Geology Bureau has gathered 50 linear survey kilometers of geophysical data, and drilled 25 oil and gas exploratory and resource evaluation wells, a total of nearly 100,000 shaft-feet. He said exploration for oil and gas must be increased to make new major finds and breakthroughs to get even more oil and gas geological reserves, and deliver, by the end of the Eighth 5-Year Plan, one or two additional reserve prospecting and development bases.

On 8 April, the Shanghai Marine Geology Prospecting and Development Corporation hung a sign commemorating the transformation of the Bureau from a land survey unit into a prospecting and development industry. The Corporation, based in Pudong, has eight geophysical prospecting well drilling and engineering companies with 100 million yuan in registered assets.

Vice Minister Zhang Wenyue of the Ministry of Geology and Mineral Resources, and Vice Mayor of Shanghai, Xia Keqiang, attended the meeting and gave speeches.

Shanghai Delivers 'Steamer' to Daya Bay

936B0062A Shanghai JIEFANG RIBAO in Chinese 5 Feb 93 p 1

[Article by reporter Zhang Zhiyuan [1728 5268 6678]: "Shanghai Manufactures a Nuclear Power 'Steamer', Ships It Out On 4 February, The Only Chinese-Made Large Component for Daya Bay Nuclear Power Plant, To Be Tested by the Nuclear Power Plant After Installation of the Steamer Training Simulator"] txt

[Text] A steel "steamer" 4.3 meters high and 4.8 meters in circumference was loaded onto a 20-ton flatbed truck on 4 February 1993 for shipment to Daya Bay in Guangzhou where it will become the only large Chinese-made component at China's first 900MW nuclear power plant, and it will undergo simulation testing in 10 days.

The regular name of this super-grade "steamer" is a nuclear power steam generator training simulator. It will play an essential and important role in guaranteeing normal operation of the nuclear power plant. When a breakdown occurs in a steam generator, which is a key nuclear power device at a nuclear power plant, the threat of radiation to the human body makes it impossible for inspection and repair personnel to enter the shut down steam generator immediately, so they must undergo strict training on an identical simulator, repeat the entire inspection and maintenance process several times until they are proficient and make no errors, and then work in coordination with robots in going to the device and rapidly eliminate the breakdown. Based on current electricity price computations, a reduction of 1 day in the amount of time spent on inspection and maintenance during a shutdown of the 900MW nuclear power plant can produce $880,000 in benefits. It is precisely for this reason that this externally identical nuclear power "big steamer" which is fitted with a boiler is so important. An imported unit would cost over 1 million francs and transporting one from France and to China by air would cost 4 million francs. Technical personnel and workers at China's biggest specialized power plant auxiliary equipment manufacturing plant, Shanghai Power Plant Auxiliary Equipment Plant, resolved to manufacture a unit themselves that was designed by the Nuclear Power Institute and fought hard night and day without even resting on New Year's Day and the Spring Festival. In the end, they completed China's first multifunction nuclear power plant steam generator simulator whose quality attained advanced world levels and ended the situation of importing every bit of the large equipment for Daya Bay Nuclear Power Plant from foreign countries while spending just one-fifth as much as it would have cost to import the unit.

The truck convoy leaving Shanghai (one 20-ton truck, one 10-ton truck, and a tool truck) raised clouds of dust as they reached Daya Bay in one week. They carried with them the pride of Shanghai's S&T personnel and the working class because only a few of the world's industrially developed countries are presently capable of manufacturing this big 11-ton tool that was loaded on the trucks. The 900MW Daya Bay Nuclear Power Plant will begin trial operation on 28 February 1993. This Shanghai-made "nuclear power steamer" will soon be "standing" at its post and play an important role in ensuring operation of the nuclear power plant.

Daya Power Plant Unit Loaded With Nuclear Fuel

OW0206081893 Beijing XINHUA in English 0732 GMT 2 Jun 93

[Text] Shenzhen, 2 June (XINHUA)—The first generating unit of the Daya Bay nuclear power plant in south China's Guangdong Province completed the loading of nuclear fuels Tuesday [2 June].

According to the scheduled requirement, the generating unit will be jointly supported by the Guangdong and Jiulong grids to carry out a critical test after being loaded with fuel, then it will join the grid to generate electricity, raise the power and undertake trial operation.

It is expected to officially go into commercial operation by the end of this year after passing tests.

An official of the Daya Bay Nuclear Power Plant said that the plant's construction and preparation for production are proceeding well.

The installation, tests and preparation for production of the first generating unit before being loaded with nuclear fuels earlier passed strict examination and appraisal by the National Nuclear Safety Administration, the State Environmental Protection Bureau and the China National Nuclear Corporation respectively.

On May 28, strictly following operational procedures, workers began to load nuclear fuels into the generating unit.

Hainan Wants To Build 350 MW Nuclear Power Plant

40100091B Beijing CHINA DAILY (Business Weekly) in English 7 Jun 93 p 1

[Article by Huang Yiming]

[Text] Haikou—China's southern island province of Hainan is planning to build a nuclear power plant with a capacity of 350,000 kilowatts, according to China National Nuclear Corporation (CNNC).

Chen Zhaobo, executive vice-president of CNNC, told Business Weekly the facility will be located in Dongfang County, in western Hainan. The location is said to be protected from typhoons and ideal for nuclear plants.

The Hainan plant, which is yet to be approved by the central government, will be jointly built by CNNC and Hainan Electricity Corporation.

China has already built two nuclear power plants, one in Zhejiang Province's Qinshan and the other in Guangdong Province's Daya Bay. The Qinshan plant, with a generation capacity of 300,000 kilowatts, started operation in 1991. Another plant with two 600,000-kilowatt generators, will soon be built during Qinshan's second phase.

And plans are in the offing to build more nuclear power plants to ease China's power shortage. Zhejiang and Guangdong have proposed to build a second nuclear power plant in each province. Liaoning Province in Northeast China has agreed with Russia to jointly build such a plant with two 1-million-kilowatt units.

Chen said preparations are under way for the project, which is supported by the Hainan provincial government.

He said another plant of similar capacity will be added in the second phase of construction.

Construction of each plant will take 5 to 7 years and the two plants will cost 2 billion yuan ($344 million).

Investment will be raised by issuing shares and foreign funds will be sought, Chen said.

He said nuclear power is the best way to solve the energy shortage in Hainan, which does not have coal or oil resources for thermal power plants. Transporting such fuel from the mainland would be costly.